**YUCATAN:LONDON INTER-UNIVERSITY COLLABORATIVE PROJECT**

# "OPTIMISING THE INTEGRATION OF LIVESTOCK INTO SMALL-SCALE LOW EXTERNAL INPUT CROP SYSTEMS"

Participatory research in campesino agriculture


Project Manager & Researcher: Simon Anderson
Researchers: Susanne Clark, Bernadette Keane, Julieta Moguel, Wilbert Trejo

Collaborators: David Leaver & Andrew Dorward, Wye College
Raul Godoy Montañez & Roberto Belmar Caso, FMVZ-UADY

Participating Campesino Communities:
San Juan de Bautista Sahcabchen & X'culoc, Campeche;
Xohuayan & Sahcaba, Yucatan; SE Mexico



Supported by the DFID Livestock Production Programme
NRI Contract no.: ZC0075
DFID Project ref.no.: R6982

# OPTIMISING THE INTEGRATION OF LIVESTOCK INTO SMALL-SCALE LOW EXTERNAL INPUT CROP SYSTEMS

## PROJECT SUMMARY

The small-scale low external input crop systems (SSLEICS) managed by campesino households in Latin America are experiencing dramatic changes that impinge heavily upon traditional natural resource use strategies. Facilitation of endogenous responses to these changes is required. Enhancing the integration of livestock into low external input crop systems at the forest/agriculture interface presents an opportunity for maginalised campesino households to consolidate existing, and to develop new, regenerative practices that harmonise agricultural development and forest conservation. A participatory research initiative between campesino producer families and researchers is reported here. Issues addressed in the project were: the amount, quality and complementarity of animal feed sources available from SSLEICS; possible livestock/crop interactions; and the socio-economic and gender impact of integrating the livestock component.

The research was carried out in a collegiate manner between campesino households and researchers so that the integration strategies developed were appropriate for identified uptake pathways. Conventional research support was provided as the need was identified through participatory appraisal.

The field work and campesino/researcher workshops were carried out at four sites in SE Mexico representative of forest/agriculture interface regions in Latin America.

# 1. LITERATURE REVIEW

## 1.1. INTRODUCTION

Livestock play fundamental roles in a number of processes within small-scale agricultural systems e.g. nutrient cycling, providing traction, daily income and a means of saving (Loker, 1994). Optimising the integration of livestock into forest margin agriculture could stabilise production, improve family livelihoods and arrest the destruction of primary forest (Anderson, 1990). In a recent study the FAO (FAO, 1995) concluded that land shortage in marginal areas will be a positive force for integrating crops and livestock. To enable this to happen research into legume based relay, intercropping, soil conservation and other practices to raise the supply of high protein feeds and forages is required (FAO, 1995). Crop x livestock interactions merit adding to this list.

Throughout Central and South America, campesino farmers have been involved in measures to conserve and improve soils, and diversify and increase crop productivity (Bunch and Lopez 1995). These innovations have successfully improved soil quality and crop productivity but poor and unpredictable crop prices have often made these practices economically non-viable. Campesino producers use legumes for weed control and to improve soil fertility with indirect benefits in improved crop production in Bolivia and Brazil (Kiff, Pound and Holdsworth, 1996) and in Mexico (Anderson, Gündel and Jimenez Orsonio, 1994). However, frequently these techniques have been abandoned in favour of cash crops, including sowing pastures to rent, that do not enhance soil fertility and are less sustainable. This economic constraint could be removed by using legumes and other crop products to feed animals, thus aggregating economic value to the legumes. Additionally, animal wastes would become available to add to the soil. Kiff, Pound and Holdsworth (1996) concluded that "... research on the integration of livestock with cover crops should be conducted in a farming systems context."

Participatory research and development projects both in Bolivia and in Mexico (Yucatan:London Inter-University Collaborative Project) have shown that some SSLEICS producers keep animals and that many more are interested in optimising livestock integration, (Anderson and Ferraes, 1995). Due to the highly seasonal variation in the quality and quantity of crop products and by-products available for livestock feeding, research is necessary to identify appropriate innovations/strategies, and then promote these techniques (D'Mello and Devendra, 1995; FAO, 1986).

The crops and legumes most widely grown in such SSLEICS are; maize, cassava and other tubers, squash, native bean varieties including *Vignas* and *Dolichos*, *Canavalia ensiformis, Mucuna*

*puriens, Arachis pintoi*, chillies and other horticultural crops. The nutritive value and anti-nutritive properties of a few of these crops, their products and by-products have been investigated (e.g. D'Mello and Walker, 1991; Belmar and Morris, 1994). However, important questions in different areas remain to be answered before effective strategies for the optimal integration of livestock into such cropping systems can be developed. These include:

*Livestock nutrition:*

- the nutritive value of legume forages (eg.*Mucuna pruriens*) for non-ruminants and ruminants
- development of low cost treatments to overcome the anti-nutritional properties associated with feeding legume materials.

*Crop x livestock interactions:*

- how best to enhance nutrient cycling with animal waste, refused forage and other organic residues
- what is the potential value of folding animals and/or poultry over land to be cultivated.

*Socio-economics:*

- how does the integration of small-scale livestock keeping (generally a woman's domain) into cropping systems (often a male domain) affect the benefits derived by the family from the innovations adopted
- does the integration of livestock into small-scale systems improve the family livelihood and/or the economy of the agricultural enterprise
- how is this affected by external factors such as the proximity of markets.

This review of literature is divided into two sections. The first deals with the biological aspects of crop/ livestock integration and concentrates on the utilisation of cover crops for feeding livestock. The second section looks at the socio-economic aspects of livestock keeping and the contribution of this activity to peasant household livelihoods.

## 1.2. BIOLOGICAL ASPECTS OF CROP/ LIVESTOCK INTEGRATION IN PEASANT AGRICULTURE IN LATIN AMERICA

This section draws on the material prepared for Anderson, Gündel, Pound and Triomphe (2001): *Cover Crops in Smallholder Agriculture: Lessosns from Latin America.*

Here the benefits and drawbacks to different forms of cover crop/livestock integration are explored. The terms food, feed and forage are used to denote the products and by-products of crops, pastures, cover crops and livestock. Crop, cover crop and livestock products consumed by people are "food"; crop and cover crop grains, tubers and non-leaf products that livestock consume are "feed"; other crop; pasture and cover crop products are "forages". Products are the outputs from components of a farming system that the farmer considers the main purpose of managing the component. By-products are a component's secondary outputs from the farmer's point of view.

Before considering the ways cover crops and livestock can be integrated, the human food aspects of cover crops, especially legumes, are discussed

### Legumes as part of the human diet

Legumes are an important part of people's diet in different regions the world, especially in poorer regions where they often provide the only regular source of proteins or amino acids. The consumption of legumes is variable. In Latin America relatively high levels are consumed, 40 to 70 grams DM/day/person, as compared to Sri Lanka, Malaysia and Indonesia with 15 to 20 grams DM/day/person (Borget, 1992). Apart from their high protein content, legume seeds contain appreciable levels of carbohydrates and some are rich in oils. The table below presents the nutritional value of some legume species common in the tropics.

**Table 1. Nutritional content of some legume species common in the tropics*.**

| Legumes | Proteins | Fats/oils | Carbohydrate |
|---|---|---|---|
| Groundnut | 20-33 | 42-48 | 22-25 |
| Pigeon pea | 15-29 | 1-3 | 60-66 |
| Soya bean | 37-41 | 18-21 | 30-40 |
| Dolichos | 24-28 | 1-2 | 65-70 |
| Lima bean | 19-25 | 1-2 | 70-75 |
| Common bean | 20-27 | 1-2 | 60-65 |
| Winged bean | 30-40 | 15-20 | 35-45 |
| Cowpea | 22-26 | 1-2 | 60-65 |

(*Contents grams/100 g of entire mature seed) *Source:* Borget (1992).

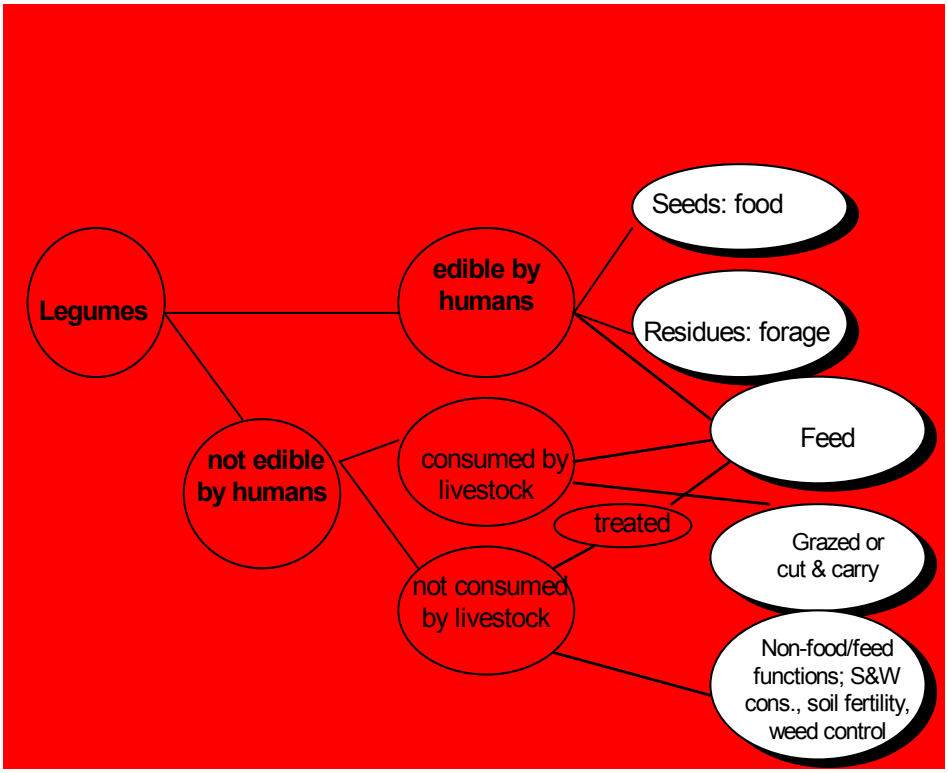
Farmers who practice low-external input agriculture (LEIA) generally consider the edibility attributes of legumes used as cover crops as important. In their traditional farming practises, the

significance of the multiple uses of cover crops is well known. In small-scale farming systems legumes are commonly cultivated with other staple crops like maize and millet, as intercrops, relay crops or in rotations (e.g. in Central America: maize and Vigna spp. and/or Phaseolus spp.)

The contribution of cover crops to human diets has been neglected in many projects and studies. However, the edibility of cover crops is a prime concern of farmers and leads to preferences between varieties. Introduced cover crops have been chosen, largely by scientists, on the basis of characteristics other than their attributes as components of human diets. However, farmers immediately raise this question when they are introduced to a new species. Mucuna spp. is considered as an edible legume in Java and Nepal, where it is traditionally prepared as a fermented beverage. In Central America, efforts have been made to promote the use of Mucuna as a constituent of beverages, tortillas and bread. However, these promotion efforts have been hindered by people's wariness of a toxic component (L-dopa) in Mucuna seed, which requires cooking before it is safe for human consumption. Cases of dizziness, vomiting and short-term affects on eyesight have been reported after the consumption of Mucuna. Recommendations to avoid negative effects of Mucuna consumption include boiling, changing of water and limiting the amount of Mucuna intake. In situations where farmers already produce local legume species for consumption, it might not be necessary to promote the use of Mucuna for human diets. Rather, it can make a major contribution to the animal diets (see evidence from recent Mexican research below).

The diagram below shows the different possible contributions of cover crops as food, feed and/or forage. Non-legume cover crops also provide food such as sweet potato (aerial parts of plant used as animal forage) and cucurbits. There is a real need to seek out cover crops with a human food potential.

**Figure 1. The different possible contributions of cover crops as food, feed and/or forage.**




## Livestock within low external input agriculture

More than 85 percent of all livestock (ruminants, pigs and poultry) that exist in the tropics are in small-scale farming systems (Wilson 1995). The purposes of commercial livestock producers are well known - profitability through the sale of meat, milk, eggs, skins, wool and fibres etc. The purposes that semi-commercial and subsistence producers, those largely involved in LEIA, have in owning livestock we understand less well. Wilson (1995) presents a list of purposes that LEIA producers might have in owning livestock:

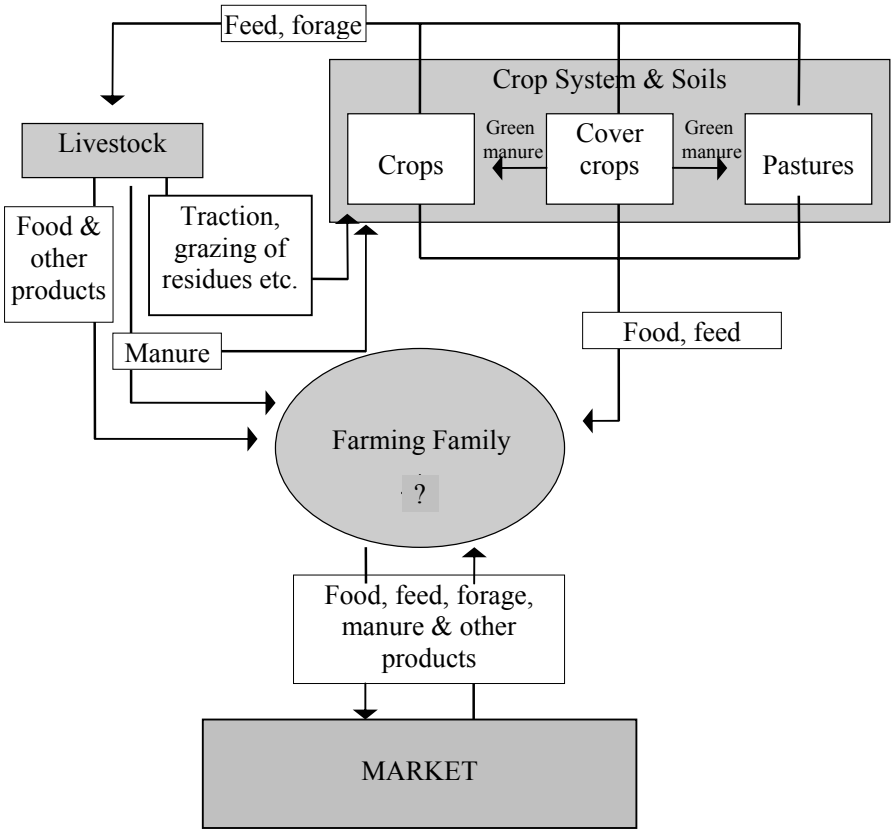
- diversify production in order to reduce risk
- generate and accumulate capital
- provide services for crop production (work, fertiliser, fuel)
- fulfil customs and rituals
- lend status and prestige to the owner
- provide food and other products
- generate income.

Not all LEIA producers will share all these purposes. However, we can conclude that livestock in LEIA have various functions and farmers have different multiple purposes which drive their livestock husbandry.

## Crop, cover crop, pasture and livestock interactions

Figure 2 shows some of the interactions between crops, cover crops, pasture and livestock in an integrated farming system.

**Figure 2. Interactions between crops, cover crops, pasture and livestock in an integrated farming system**




The diagram shows that crops produce food for the farming household and for sale, and feed and forage for livestock. Cover crops fulfil green manure and weed control functions for soils and crops, and produce feed and forage for livestock. They might also produce food for the farming family. Livestock produce food and other products for the farming family and for sale, and manure for the soils and crop systems. Where livestock are used for traction, cover crops can be ploughed into the soil or crushed and chopped using a bladed roller prior to planting a staple food crop, as occurs in Brazil.

A number of trade-off decisions have to be made in the allocation of products and by-products produced in the farming system and utilised by other components, or sold to the market. Table 2 below lists some of these. The trade-offs of most interest here are those whereby cover crop products and by products are allocated to soil and water conservation, soil fertility and soil cover roles (known as green manure and weed control functions) and for feeding livestock.

Livestock contribute to crop production both in direct ways - work, manure etc. and in indirect ways. Livestock products are quite often of high value, and can usually be sold easily at moments convenient to the vendor. Hence, income from livestock sales can be invested, when required, in crop production (including cover crops). By converting crop and/or cover crop products and by-products into livestock products, economic value is often aggregated. For instance, by feeding maize stover to small ruminants, or legume grain to pigs or poultry, the income generated from the sale of the livestock product (allowing for the conversion efficiency) is greater than would have been achieved by selling the crop by-product.

LEIA producers seek synergies between the components of their farming systems. In this respect, the utilisation and cycling of nutrients are critical factors in the husbandry of crops, cover crops and livestock. In mixed farming systems, nutrient cycling is often mediated through livestock. Livestock increase the farmers' options for managing nutrient flows in terms of their spatial and temporal placement, increasing nutrient turnover in the production cycle, synchronise nutrient demand and supply, and reducing nutrient losses (Steinfeld, de Haan and Blackburn, 1997). Incorporating legumes into a farming system is one of the very few ways to generate new nutrients (rather than importation as fertilisers, composts, silt etc.). The harnessing of nutrient generation with the enhanced capacity for nutrient allocation, recycling and maintenance through crop / livestock integration demonstrates some of the possible synergies that can accrue through combining cover crop and livestock husbandry. Stobbs (1969) demonstrated how including legumes in pastures not only improves animal performance but also has positive effects on the yields of crops that follow the pasture / legume association.

**Table 2. Some of the trade-offs involved in crop / pasture / cover crop / livestock integration**

| Resource | Trade-off decision | Possible outcomes | Comments |
|---|---|---|---|
| **Land** | Allocation between market, crops, cover crops, pastures or fallow | 1. sold or rented<br>2. sown to crops<br>3. sown to cover crops<br>4. sown to pastures<br>5. left fallow | 2. to 5: All outcomes can be combined temporarily or spatially |
| **Crop - grain** | Allocation | 6. family consumption | 6. to 9: Outcomes mutually |

| | | | |
|---|---|---|---|
| | between family, farm, market or livestock | 7. sold<br>8. seed for crops<br>9. feed for livestock | exclusive but grain available can be proportioned to different outcomes |
| **Crop - forage** | Allocation between farm, market or livestock | 10. organic matter for composting or soil incorporation<br>11. forage for sale<br>12. forage for livestock | 12: Forage transformed into livestock products (with possibility of aggregated economic value) including manure. Forage can be cut & carried to livestock and manure collected, or livestock folded over crop land |
| **Cover crop – grain** | Allocation between family, farm, market or livestock | 13. family consumption<br>14. sold<br>15. seed for cover crops<br>16. feed for livestock | 13. & 16. Anti-nutritional factors may be a problem. |
| **Cover crops – forage** | Allocation between farm, market or livestock | 17. green manure functions<br>18. forage for sale<br>19. forage for livestock - grazing or cut & carry | 17: Cover crops can be used to regenerate degraded pastures.<br>19: Direct competition between weed control and green manure roles and utilisation for livestock. However, completely under farmers control. Cutting might stimulate re-growth, roots not affected by grazing. |
| **Livestock - food & other products** | Allocation between family and market | 20. family consumption<br>21. sold | |
| **Livestock – manure** | Allocation between family, market and farm | 22. fuel for family<br>23. sold<br>24. fertiliser | 24. Timeliness and precision in spatial allocation; way of transferring nutrients from low to high potential, or to areas of greatest need. |

There are a series of limitations in the use of cover crops for livestock.

- Price and availability of cover crop seed varies tremendously. Limited supply results in high prices and hence livestock feeding is not viable. Low prices often act as a disincentive to harvesting the seeds. Hence, in the short term until price responds to demand, availability is adversely affected.
- Grazing of cover crops might adversely affect the development of the plant and restrict the crop's ability to fulfil other biophysical functions (in other cases grazing can be used to reduce crop/cover crop competition).

- Husbandry practices that can optimise the utilisation of cover crops for various functions including green manuring, weed control, soil moisture conservation and providing livestock feed and forage need to be investigated.
- Anti-nutritional factors are found in many cover crops that inhibit their use for livestock feeding, and resources have to be allocated to the treatment prior to feeding.

Table 3 shows some uses of cover crops for livestock feeding found in Central America. Before the cover crop grains such as Lablab, Mucuna and Canavalia are fed to livestock, treatments are carried out to reduce anti-nutritional factors and to improve voluntary intake. These treatments include toasting, boiling (changing the water on occasions), grinding, soaking and germinating (see below for results of recent work on feeding Mucuna beans to chickens.)

**Table 3. Cover crops used for livestock feeding in Central America**

| Country | Cover crop and use |
|---|---|
| Mexico | • White clover fed to sheep and cattle (Mixteca, Oaxaca)<br>• Maize stover and Canavalia beans fed to goats (Yucatan)<br>• Mucuna bean and forage fed to pigs (Yucatan) |
| El Salvador | • Sorghum straw and Lablab (dolichos) fed to cattle<br>• Forage peanut fed to cattle and goats |
| Honduras | • Maize stover and Lablab (dolichs) fed to cattle and horses<br>• Campanilla (vigna) fed to cattle and horses |

*Source:* Anderson et al., 1997

During a regional workshop on cover crops (Anderson et al., 1997) a working group consisting of representatives of NGOs, farmers groups and researchers discussed the integration of cover crops and livestock in mixed farming systems. Their conclusions on the socio-economic aspects are presented in Box 1 below.

**Box 1. Conclusions from discussions on the socio-economic aspects of cover crop / livestock integration. Regional workshop on cover crops (Anderson et al., 1997)**

It is considered that those socio-economic aspects of cover crop/livestock integration are less well understood than technical issues. However, the following points are important.

- The hypothesis that cover crop use can increase staple food production and reduce the amount of staple grain fed to livestock requires testing under different conditions.
- The integration of livestock into a farming system depends upon the productive capacity of the farm and the resources available to feed livestock. It is important to carefully identify the families with the capacity and interest to incorporate livestock into their farming system before any such project is initiated, and in order to do so a participatory appraisal is required.
- Without an adequate market for livestock products the potential for integrating livestock and cover crops in a farming system to provide for seasonal shortages of food, and/or an extra income source, will not be achieved. Worse still, the need to feed the livestock could prove a severe burden for the family.
- The integration of livestock can result in increased demand for rented pasture and/or purchased feed or forage (from cover crops) thus stimulating the local market, and transactions between families with access to different resources.
- At the regional and/or national level feeding livestock with cover crop products may provide an alternative to imported grains and concentrate feeds.
- Livestock husbandry has the potential to improve family diets. However, the promotion of feeding grain to livestock (notably poultry and pigs) should not take place unless family food security is assured. The introduction of cover crops suitable only for livestock and not human consumption should only take place in circumstances where the achievement of family food security is possible using other resources.
- The use of cover crops for livestock feeding could impose significant increases in the work load of female family members, especially where treatment of the grain is necessary. The same treatment might also mean an increased use of resources, such as firewood and water that might be scarce.

## Impact on the environment

Mixed farming is considered beneficial for the land where soil fertility is maintained by crop rotations. Where legumes (cover crops) are incorporated into the farming system they may function as nutrient providers, forage sources and restrict erosion. Integrating livestock into a farming system and incorporating manure does not generate nutrients or reduce nutrient surplus *per se*. What this form of husbandry can do, if effectively managed, is to increase soil organic matter and enhance soil micro-flora and fauna.

The key question is one of maintaining the nutrient balance, and here we have to be very clear about what size of land unit are we considering. For example, depleting nutrient reserves from land around the farm by grazing livestock on common land during the day and then collecting their manure (from night pens) for use on the farm, might maintain the environment of the farm, but damaging the wider environment. Hence, innovations that allow the balancing of nutrient

status within the farm help maintain the wider environment. Crop/livestock integration offers management tools to the farmer which assist in the balancing of farm nutrient status. The inclusion of leguminous cover crops in the mixed farm provides the farmer with a broader repertoire of management options and most importantly, the potential for generating nutrients from available resources (it is often assumed that legumes have active rhizobia; this may not be the case particularly for immature plants).

Conservation NGOs, particularly those working in the buffer zones around protected areas, are looking for ways to influence farmers practices so that the negative impacts of land husbandry are reduced and positive impacts enhanced. A case in point is the work of Pronatura Peninsular Yucatan, in SE Mexico, which together with the Autonomous University of Yucatan, has promoted cover crop use by campesino farmers in the buffer zone around the Calakmul Biosphere Reserve (see Box 2 below). The NGO decided to develop home-garden pig keeping as a way of consolidating the use of Mucuna as a cover crop in maize production. Studies have been undertaken to evaluate the impact of this initiative. However, the basis of the project is the enhancement of nutrient cycling in the maize plot/forest/home-garden system. Firstly, through the introduction of cover crops to improve soil fertility and reduce weed invasion and hence extend the fallow periods. Secondly, by the introduction of Mucuna feeding to pigs to aggregate economic value to the Mucuna bean, thereby encouraging farmers to cultivate Mucuna.

Little scientific information exists about the environmental and ecological impacts of cover crop/livestock integration in farming systems. Whilst acknowledging this dearth the participants in the Regional Workshop on Cover Crops (Anderson et al., 1997) drew the following conclusions.

- The integration of cover crops and livestock can improve the bio-economic efficiency, and hence the stability of a farming system both in spatial and temporal dimensions. In turn, this improvement in stability could have a positive effect on the conservation of natural resources both within and around the farm.
- Livestock husbandry could reduce the need to hunt wild animal species to augment the family diet. The time saved by not hunting could then be usefully employed in farm management.
- The integration of cover crops and livestock is a means of intensifying the management of the farming system, enabling the support of a higher human population per unit area. In turn this intensification of land use would reduce the need to exploit the remaining natural resources (including forests) and biodiversity.

Despite these potential advantages, there are relatively few examples of cover crops being successfully used as livestock feed or fodder. Farmers and researchers are working together in SE Mexico in an attempt to unleash this potential.

**Box 2. Maize, Mucuna and pigs in Calakmul, Mexico**

The Calakmul Biosphere is part of a tropical forest that extends from the Petén in Guatemala, into north Belize, and across the Mexican states of Quintana Roo and Campeche, and into Chiapas. It is the most important tropical forest of the Americas north of the equator. Unfortunately, the forest is not intact, being formed of separate reserves in the three countries mentioned. The Biosphere is made up of 227,860 hectares of nucleus and 494,140 hectares of buffer zone. There are 72 communities within the buffer zone, the majority of whom have been displaced from other regions of Mexico.

Pronatura Peninsula Yucatan is just one of the development organisations working in the zone. Their mission is to contribute to the conservation of ecosystems of the Yucatan. In Calakmul, Pronatura are involved in projects to develop organic agriculture, bee keeping, home-gardens, reproductive health, and eco-tourism. Maize is the staple food of all the Calakmul communities and it is produced through a slash & burn agriculture. These practices are considered to threaten the biosphere and Pronatura has sought to ameliorate the effects of maize production by introducing cover crop use and other forms of organic agriculture.

After three years of pushing Mucuna use in the Calakmul region, the low adoption rates and abandonment of cover crop technology by farmers caused concern and it was decided to develop other uses for cover crop products. In association with the Autonomous Unversity of Yucatan, Pronatura embarked upon a project to foment the use of Mucuna beans as feed for small-scale pig production. The objective of the project was to develop a system of livestock production integrated in such a way into the organic crop system that efficient use could be made of crop products, leading to an aggregated economic value.

Farming families that had sown Mucuna were invited to participate in the project. They were given one or two sows, on a revolving fund basis, once they had built suitable pig-pens and had attended workshops where pig husbandry knowledge was discussed.

The project has been running for some years and initial results are available on sow and litter performance (see later in the chapter). The impact of the project on campesino agricultural system is at present being evaluated.

*Source:* Case study presented at the Regional Workshop on Cover Crops by Pronatura Peninsula Yucatan (Anderson et al., 1997)

## 1.3. LIVESTOCK AND LIVELIHOODS

### Introduction

It has been calculated that some 70 percent of the world's rural poor depend on livestock as a component of their livelihoods. This sector includes 640 million poor farmers in rainfed areas, 190 million pastoralists in arid or mountainous zones, and more than 100 million people in landless households.

Livestock comprise one part of a household's asset portfolio. Assets are drawn upon by households to enable activities and hence to sustain their livelihoods. Livestock assets can be used for different purposes. It is the objective of this review to appraise the information available on the contribution of livestock assets to household livelihoods, through livestock keeping activities.

Ellis (1993) provides a useful definition of the type of household that interests us here: "Peasants … a type of farm family that is neither fully committed to production for sale in the market, nor confronted with competitive markets in all the inputs and outputs of the farm."

### Characteristics of Peasant Households

General characteristics of peasant households have been described by a number of different authors, some example are given here.

- Waters-Bayer and Bayer (1992) state that in the past traditional farmers were regarded as irrational in their economic behaviour and reluctant to accept new technology. However, in recent years economists and social anthropologists have found that smallholders can be just as rational or efficient in allocating resources as market-oriented profit-maximising producers, but their aims are more complex. The provision for household needs is the prime objective rather than profit maximisation *per se.* The maximisation of use-value of resources is prioritised over the maximisation of the market value of their stock (ibid.).

- Peasant households have a dual economic nature in that they are both a family and an enterprise. They make decisions based on both production and consumption goals, which distinguishes them from other farm enterprises (Ellis, 1993).

- Peasants generally pursue diverse livelihood activities rather than specialising in any particular activity. They have a livelihood portfolio of a number of different activities,

which are often natural-resource based and may be supplemented by trade, wage labour and crafts to provide for various household needs and ensure against risks (Waters-Bayer and Bayer, 1992).

- Resources often have multiple uses. They may be complementary or competitive. This is significant when crop-livestock interactions are considered. The use of animal manure to fertilise soil where crops are grown or the cyclical allocation of fields to cropping and herding are examples of the complementary use of resources. However, there may also be tensions over the allocation of scarce resources to different livelihood activities. Competition may exist between the allocation of land resources to human versus animal needs, and grain for animal or human consumption (McCorkle, 1992).

- Peasant households are vulnerable to uncertain events. They often have insufficient resources to act as buffers during critical periods. Uncertainty arises in many different spheres. Natural hazards such as floods, droughts and pests may deplete harvests and ruin the local economy. Seasonal changes although predictable in their occurrence are less predictable in their impact. Seasonal changes may occur in terms of reduced food supplies – the 'hunger gap', increased prices for staples, human and animal illnesses, pest attacks, labour demands etc. Politically, households are vulnerable to changes in policies such as rural development policies, agricultural subsidies etc. that influence household decision-making. Social uncertainties may have profound effects on the households for example an illness in the family, which may incur high medical bills and a labour reduction. In the economic sphere, households are fundamentally characterised by partial engagement in markets that tend to function with a high degree of imperfection: "with one foot in the market and the other in subsistence they are neither fully integrated into that economy nor wholly insulated from its pressures" (Ellis 1993).

- Peasant households take account of such uncertainty within their decision-making and they are risk-averse (Ellis, 1993). There is controversy as to whether risk-aversion increases as incomes increase or remains the same. Risk-averse behaviour results in the sub-optimal use of variable inputs (Ellis, 1993). Households often pursue risk reducing or mitigating strategies. New innovations present risks to households, for example, technologies with a high dependence on external inputs are often rejected in high-risk environments (Fernandez, 1992)

- It has been recognised that farmers have the capacity to experiment, adopt and innovate (Chambers, 1994). They are constantly changing, even without the direct influence of

development programmes. Many conduct small-scale experiments (Waters-Bayer and Bayer, 1992).

## Peasant livestock keepers

Peasant livestock keepers are not a uniform group. It is useful to distinguish between different livelihood systems that involve livestock keeping. Waters-Bayer and Bayer (1992) discuss four main types:

- full-time livestock keepers who depend primarily on livestock for their livelihoods (they may be nomadic, sedentary or transhumant)
- livestock-keepers who do some cropping but livestock remain their main means of living (may be transhumant or settled)
- crop farmers who also keep animals and usually stay in one place all year round
- the landless who keep some livestock as a 'sideline' activity and often live on the edge of villages, towns or cities.

These categories overlap in nearly all cases with those target groups of livestock keepers that DFID's Livestock production Programme (LPP) has recently identified:

- small-scale dairy cow keepers
- crop/livestock keepers
- small stock keepers
- landless livestock keepers
- pastoralists and other transhumants.

Women livestock keepers may fall into the small stock keepers or the landless livestock keeper categories, depending upon their land endowment and right of use within the family.

## Livestock's contribution to livelihoods

Much analysis has concentrated on the income-generating role of livestock. However, experience shows that livestock do not only provide smallholders with a source of food and income, but also perform a variety of other functions to meet diverse household objectives. For example, as a buffer against risk within critical periods and as a form of savings.

In a study of swine production in Central America it was revealed that 97-99 percent of production is on family farms. However, low productivity was a characteristic of such systems.

Economic studies assessed them to be unprofitable, wasteful due to high mortality, to have low reproductive rates, poor feed conversion and produce poor quality final products. The apparent contradiction between poor performance and the prevalence of small-scale swine production confused economists (Quijandria, 1981). It implies that farmers have other objectives than the maximisation of income generation and that livestock perform other vital functions for livestock keepers.

Jahnke (1982) refers to four main functions of livestock:

- output function - the production of food and non-food products for home consumption or sold for cash income
- input function - livestock contributes to farm productivity as an input e.g. manure or the productive use of non-arable land
- assets and security functions - livestock as a risk reduction strategy employed on the farm
- social and cultural functions.

These and other functions are explored below and summarised in Table 4.

**Livestock as food**

Livestock products such as meat, eggs and milk are all high in protein and sources of energy, minerals and vitamins. Although cereals are the staple foods of smallholders, they generally place a high value on food from livestock. Meat is often saved for special occasions.

Livestock are relatively more expensive than other sources of food. Poor households thus consume smaller quantities of meat than other cheaper foods, in comparison to wealthier households.

**Livestock as a source of cash**

Daily off-take such as eggs and milk may provide regular sources of income. Larger sums of money are obtained by sales of animals for expenditures such as payment of fertiliser, medical bills and construction materials. Nimis (1982) states that amongst the Maya in Belize, pig sales are used to purchase material, clothes, shoes, school necessities, repay loans, and purchase commodities which the household cannot produce. Household economic studies in Nigeria (Waters-Bayer, 1988) showed that farmers derived more than half of their cash income from animal sales. According to Sansoucy (1995), the sale of livestock products can account for up to 80 percent of the regular cash income of small-scale farmers.

Kurosaki (1995) states that livestock have a value that can be realised at any time, and that capital is thus easily accessible. However, others (Dorward, Anderson and Clark, 2001) state

that transaction costs may be incurred (such as spending time finding purchasers) and thus implies that the value of livestock is not necessarily realisable at any point in time.

**Livestock as raw materials**

The non-food livestock products may also be an important source of material and income for households. Wool, hide, feathers and bones are commonly used. The processing of such raw materials, often by women, may constitute an important part of the livelihood portfolio.

**Table 4. The purposes of livestock production**

| Category | Specific purpose | Comments |
|---|---|---|
| Socio-economic | Generate income | • Sources of cash income that can be in relatively large discrete amounts (e.g. from selling a cow), or in more frequent small amounts (e.g. by selling smaller stock, eggs, or milk) |
| | Diversify production in order to reduce risk | • Livestock allow risk diversification and may also act as a buffer to crop yield losses. Hence, livestock can counterbalance the more dramatic effects of risk-prone small-holder agriculture |
| | Generate and accumulate capital | • Physical assets that accumulate (through reproduction), can be inflation-proof and productive investments, and are available to be liquidated at times of need. |
| | Other | • Integral components of mixed crop/livestock systems where they provide draught power and manure that can be both used on the farm or traded.<br>• Livestock allow the poor to obtain benefits for their family from the exploitation of common property.<br>• Livestock ownership can be independent of land ownership and they can utilise resources that have few alternative uses |

| | | |
|---|---|---|
| To produce goods | Food: Meat, milk, eggs | • For some groups, such as pastoralists, domestic animals provide a considerable part of their food requirements<br>• For small-scale mixed farmers they are especially important in the hungry season<br>• Domestic animals are often the only source of certain essential amino acids and fatty acids; ruminants also convert cellulose into products that are digestible to humans |
| | Fibres & skins - wool, hair, leather | • Clothing - wool, hair and leather are used for making garments, blankets, shoes, etc. These may be income-earning and for subsistence |
| | Manure as fertilisers | • Animal manure is an important component of many mixed farming systems |
| | Manure as animal feed | • Pig slurry fed to cattle |
| | Manure as fuel | • In some places, animal dung is the only fuel available; in others, reduced availability of dung puts more pressure on forest reserves<br>• Methane gas |
| | Construction | • Hides, wool and other fibres are used to make shelters |
| | Utensils | • Bone is used to make a variety of utensils, leather for making bags to carry food and water |
| To provide services | Power & Traction - | • Soil cultivation, irrigation, transport<br>• Domestic animals reduce the amount of human labour required for crop production<br>• Provide services to crop production<br>• Integral components of mixed crop/livestock systems where they provide draught power and manure that can be both used on the farm or traded |
| | Storage | • Food, capital, seasonal surpluses |
| | Weed & pest control | • Biological control, pathways, waterways |
| | Sport & recreation | • Hunting, showing, pets |
| Cultural & ceremonial | | • Security and self-esteem,<br>• Symbols comply with customs and social values<br>• Give status and prestige to the owner<br>• Ceremonies - animals often play important roles in religious ceremonies and rituals |

*Source:* adapted from Holden et al. *(*1998) and Wilson (1995)

**Livestock as a means of saving**

Livestock keeping is considered one of the main means of saving for the poor (Birner, 1999; Kurosaki, 1995). Offspring provide 'interest' for livestock keepers. In addition, rather than spending the money on other consumption goods, livestock are purchased and household resources (such as feed, labour, money) are invested in rearing. In Mayan communities in Belize for example pigs are referred to as 'a larder or savings account' (Nimis, 1982). Dorward, Anderson and Clark (2001) assert that livestock is considered to be a savings strategy by the poor in order to place savings 'out of reach', given the 'lumpiness' of livestock assets.

Livestock is considered inflation proof. In a study by Swallow and Brokken (1987), it was found that investing in cattle earned farmers the equivalent of a 10 percent interest rate, while bank account lost 10 percent because of inflation rate. Estrada (1995) looked at the real value of capital invested in ruminant livestock as compared to investments in US dollars and bank deposit accounts in Bolivia, Columbia, Ecuador and Peru over the period 1970 to 1987. He showed that livestock maintained a positive, real value index, whereas the alternatives returned negative indices.

**Livestock as a source of exchange for goods or services**

Livestock can be used as a form of exchange, in particular when money is unavailable for such transactions. Nimis (1992) states how among the Maya in Belize, pig meat is bartered for goods such as wooden posts and roof materials.

Livestock and their products can also be used as exchange for labour. In the same study, Nimis (1982) discusses the preparation of meat dishes for collective work days. The dishes are given by a man's wife to a group of men who have helped on her household's land, doing work such as roof reparation or harvesting the fields.

**Livestock as a buffer against risk**

As discussed, peasant households are vulnerable and face uncertainties in a number of different spheres. They take account of risk within their decision-making, and develop means to cope with uncertain events. The literature available on the economic behaviour under uncertainty has increased in recent years and is applicable to livestock development.

Strategies to cope with risk have been divided into two categories (Kurosaki, 1995). The first category covers *ex ante* adjustments to control the risk variables, such as diversification both on and off the farm, enterprise selection (Walker and Ryan, 1990) and marketing options, including inter-linked transactions (Bardhan, 1989; Goetz, 1993). Jiggens (1986) highlights livestock as a way to contribute to *ex ante* adjustments by diversifying and contributing to a mix of different earning opportunities to reduce the risk of unexpected shortfalls in income. As Jahnke (1982) points out covariance of risk, in crop and livestock activities, tends to be lower than that of crop farming activities alone.

The second category, according to Kurosaki (1995), examines *ex post* adjustments. For example, the accumulation and reduction of assets such as savings (Deaton, 1990), the role of bullocks as a form of insurance (Rosenzweig and Stark, 1989), reliance on remittances

(Rosenzweig, 1988) and the extended family (Kotlikoff and Spivak, 1981). Numerous studies have recognised livestock's capacity to facilitate *ex post* adjustments with the provision of a source of income in critical periods. They can be used as a buffer for variations in crop yield. When the harvest is insufficient, animals can be sold in order to buy food, or slaughtered to eat. In other cases, livestock has been found to be the main strategy to cope with financial costs of healthcare (Sauerborn, Adams and Hien, 1996). In Zimbabwe, the main coping mechanism in each of four droughts between 1982 and 1995 was the sale of cattle. Those households most at risk during drought were those who did not have livestock (Kinsey, Burger and Gunnig, 1998). In Senegal, Freudenberger and Freudenberger (1994) found that the sale of chickens was the most important survival strategy for farmers in times of stress. Jahnke (1982) emphasises the security function of livestock assets, being safe and durable forms of storing wealth, earning interest in the form of offspring and by being readily disposable and convertible into cash.

However, Kurosaki (1995) argues that livestock as a form of risk diversification can be negative, given that the risk of disease and death of livestock can be high. "Animals in contrast to land and trees are mobile and very fragile. They easily suffer permanent damage from accident, diseases, maltreatment and neglect" (Binswanger and Rosenzweig, 1986). In addition, they are easily lost due to death (Birner 1999).

It should be pointed out that the sale of livestock during critical times depletes household's productive capacity for the future and reduces security against possible difficult periods. Bainbridge (1999) states how the depletion of cattle in the Namwala District in Zambia, caused household reserves to dwindle and many households became more vulnerable in times of shortage.

**Livestock as Labour**

Livestock are also used as traction in agricultural activities such as weeding, pulling loads, ploughing and threshing. Pigs may be used in the preparation of land for sowing.

**Manure Production**

Manure plays an important role in supplying the nutrients and organic matter needed to maintain soil fertility and structure on cropland. It can also be used for burning fuel for cooking or heating, to plaster walls.

**Livestock and social capital**

Livestock may be used as a means to generate social capital. Birner (1999) argues that livestock can perform a social prestige function that cannot be accounted for in the income contribution of

livestock. The value depends on the "social and cultural function of livestock" (Jahnke, 1982 cited in Birner, 1999) and can be positive or negative. Hess (1997) in her study in a highland community in Ecuador for example, found that horses and cattle are a 'macho' status symbol.

In addition, social relations are continuously affirmed by exchanges and transfers of animals, by co-operation in herding and by sharing meat from slaughtered animals (Talle, 1990 cited in Waters-Bayer and Bayer, 1992). Nimis (1982) states that when the Maya in Belize slaughter an animal, meat is given to close friends, relatives and other villagers from the same religion, provided they, in turn, reciprocate. If meat is not provided the household may be excluded from the system in the future. In many parts of Africa, livestock, not the cash equivalent are an important part of bride price payments.

Ceremonies often involve the use of livestock and their products. Nimis (1982) discusses a number of ceremonies in Belize, which use animals as an integral part of the festivities. Turkeys and pigs are used during Christmas festivities, whilst for village Saint days a pig's head is decorated with ribbons and placed on a platter with flags.

Thus, it is important to understand the multiple roles which livestock can play. These functions vary between locations and across time. They may be culturally specific and require in-depth of knowledge of social norms. For example, in one project in the central highlands of Mexico, it was found that donkeys were not locally acceptable for productive activities such as cultivation or breeding, as cultural norms dictated that they were reserved for household activities (von Keyserling, 1999). Functions may also change according to the needs of the household, indeed across the lifetime of livestock they may be used initially as animal traction and may be sold, thus used as a means of cash. They may also perform multiple functions at the same time, for example, as a means of saving, as a risk buffer, and in addition, a source of manure for crops.

Understanding the roles of livestock and the functions they perform for households is vital to the development process. Such functions should be developed and strengthened if feasible.

## Past Policies

Researchers and extensionists have long questioned why small-scale farmers have often failed to adopt "improved" agricultural technologies (Bilinsky and Gaylord, 1992). For example, research in Peru shows that many if not most of the technologies developed on research stations have not been incorporated into subsistence farming systems (Fernandez, 1992).

Fujisaka (1994) described overlapping reasons as to why poor farmers do not adopt innovations intended to improve agricultural sustainability: the problem targeted by research is not faced by poor farmers; actual practice is better than the innovation; the innovation fails in practice; or it is too expensive and what are termed 'social' factors.

Livestock in Development (1997) point to three main lessons from recent project experience, which will be addressed within this review. They concern ways in which projects have failed to meet their objectives:

- technology, goods or services have been developed but have not been delivered because the project failed to achieve its aims or local organisations were incapable of delivering services after the project closed
- the technologies which were developed were inappropriate to livestock keepers
- poor livestock keepers did not benefit even where technologies were delivered and adopted because wealthier farmers captured the benefits.

Experience of livestock development suggests that many policies were based on false assumptions about livestock keepers aims and decision-making (Waters-Bayer and Bayer, 1992). This paper discusses the multiple objectives of livestock keepers, and the costs and benefits of livestock innovations, both on an intra-household and inter-household basis. Livestock are found to perform multiple functions for resource-poor, risk-prone households and it is asserted that these functions should be strengthened in order to play a vital role in pro-poor development interventions.

## Inter-household Differences

Often the benefits of agricultural innovations are only 'captured' by wealthier farmers (Livestock in Development, 1998). Household wealth affects technology transfer in two different ways: (1) access to technology and (2) their ability to respond to and benefit from a technology.

Households have different resource endowments that affect their objectives, decision-making and livelihood strategies pursued. Birner (1999) uses economic theory to show that households respond differently to different livestock projects, depending on their resource endowments and can lead to trade-offs between the allocative and distributional goals that livestock policy makers pursue. Households that have little surplus labour time, for example, may be limited in their capacity to collect forage to feed their animals. Households with insufficient financial capital may not have the resources to buy new types of seeds. Such differences in resource endowments thus may constrain or facilitate the adoption of innovations.

Evaluation of the impact of new technology has shown that impact is often socially differentiated and may be negative for poorer sectors (IFPRI, 1998). This is not true in all cases however. In a study in Pakistan it was shown that the rural poor were predominantly livestock keepers, whilst the rural better off were cultivators of crops. Livestock interventions improved income inequalities whilst crop interventions caused further polarisation (crop and land were closely correlated, where as livestock and land had low correlation) and thus livestock interventions reached and benefited the poorest households.

Wealth-ranking is used in some farmer experimentation projects in order to determine the relative levels of wealth within communities (Grandin, 1988). Experiences with wellbeing /wealth ranking are well-documented (Pretty, 1989; Parmesh Shah, 1990; Carter, 1993). Holden, Tanner, Dampha and Jallow (1992) conducted a study of the utility of wealth ranking farmer groups in order to understand how and why innovations work, and how they can be diffused to other farmers with similar resource status.

Livestock ownership is rarely uniform within a community. In some societies, livestock are said to be a visible indicator of a family's status, as in the case of cattle in Zambia (Bainbridge, 1999). In other areas small stock are only reared by the poor (Peacock, 1996). In other societies, the ownership of livestock has very little correlation with wealth levels. Thus, livestock cannot *necessarily* be used as an indicator of wealth.

The main questions concerned with inter-household factors are:

- what are the different characteristics of different levels of wealth?
- do the poorest own livestock?
- how will different resource endowments constrain or facilitate technology adoption?
- how will resource endowments be affected by the adoption of innovations?

## Intra-household Differences

Development projects can not be conducted without prior consideration of the costs and benefits to the participants themselves. Much of the research in the past has taken the household as a single unit, and the male 'household head' as responsible for decisions. Little attention was given to the rights, interests and influences of different household members. Neo-classical economists for example have largely ignored intra-household factors. Alderman, Chiappori, Haddad, Hoddinott and Kanbur (1995) argue that the 'unitary models', which focus upon the total amount of income a household receives, have limited application to development programmes in which the analysis of individuals within the households and the balancing of their diverse interests is vital. Birner (1999) states that "in order to understand the development of a particular livestock farming system in a certain region at a specific time, one has to go beyond the pure neo-classical model and analyse the multiple objectives that drive human behaviour and the institutions by which a society regulates the utilisation of its scarce resources".

New Institutional Economics (NIE) has recently been applied to intra-household distribution and allocation analysis. Pollak (1985) advocates 'A Transaction Cost approach to Families and Households' which includes bargaining models of allocation and distribution within families. Papanek (1990) recommends the concept of 'social and cultural entitlements to resource shares'. Her approach is compatible with that of Sen (1984), who includes intra-household allocation and distribution within his analysis. Birner (1999) uses the exchange of property rights as the basis of all transactions and contractual relationships, and thus explores intra-household allocation and distribution in this context. He states that in Pakistan some of the household's resources are used and managed individually rather than by the entire household. For example backyard poultry is the 'domain' of women and therefore women have the right to manage and earn income from their poultry production. In this case, it is the individual rather than the family's time budget, objectives and preferences that influence livestock activity. Thus, the interests of different household members should be integrated in projects.

Recent literature has given more attention to the division of labour within the household and in particular the role of women. Many livestock rearing activities are undertaken by women. Women are often the owners and make the decisions regarding livestock, in particular, smaller animals such as goats, sheep and poultry. In Nepal, for example, women provide over 80 percent of total labour (Tulachan and Neupane, 1999).

Two interesting studies of the traditional and contemporary roles of Mayan women have been conducted. The former reveals that women have been important economic providers and worked in animal-rearing activities since the ninth Century (Pohl and Lawrence, 1982). Nimis (1982) states that Mayan present day women play an important role in household production by rearing animals in their home gardens for food, festivals, profit and security. Livestock provide one of the few financial assets which women can deploy. Women are responsible for both decision-making and work involved with animal-rearing activities. She comments that women maximise their productive activity by producing livestock because it represents the highest returns for the inputs involved.

It is important to consider the benefits of projects to participants. Some authors show that the benefits of livestock rearing activities are more likely to accrue to those involved (Hess, 1997; McCorkle, 1992). For example, in the Belize study, Nimis (1982) comments on how animals give women a resource that they are able to deploy, providing them with security and a degree of independence. The impact of livestock interventions and their impact on different household members have been little recorded.

Some projects have misconceived women's roles and this has had an adverse effect on stakeholders. Connelly (1992) found that intensified animal management in Western Kenya enlarged women's share of the work as they contributed to both animal rearing and cultivation of food/feed crops. Noble (1992) argues that in some societies where women do the work, and men make the decisions, failure to include men in the project may impede the uptake of technology. Birner (1999) in addition warns that children deserve special attention within development initiatives because, as the household members with the lowest opportunity cost of labour, they may be requested to work at the expense of attending school.

Labour roles and benefits within smallholder households change over time, as external influences change. In societies where men increasingly have to seek wage labour outside of the communities, women have increased livestock-rearing responsibilities.

Key questions that can be identified are:

- decision making roles of men, women, children?
- labour roles of men, women, children?
- who will accrue benefits from the innovation?
- who will manage any income derived?
- is knowledge shared within the household?
- how do these factors change over time?

## How can livestock development contribute to poverty reduction?

It is useful to take a step back, to consider how, in the past and at present, livestock have been perceived to contribute to poverty reduction.

Many development interventions in the 1970s and `80s concentrated on livestock and their products as a means to increase food supplies and food security for the domestic market, and raise foreign exchange earnings on the international market. Most development initiatives were targeted towards the commercialised high-external input sector rather than smallholder livestock keepers. The effect was to widen the gap between commercial farmers and smallholder farmers. Poor livestock keepers were unable to compete with their highly commercialised counterparts. As consumers, prices were often too high for poor livestock keepers to afford, and thus food security aims were not met, as products were often inaccessible to them.

It is useful to consider the consequences of the persistence of such policies in the current economic climate. If, as assumed, the reduction in trade barriers and the increased global economic growth will continue to lift millions of people out of abject poverty, how will livestock contribute to poverty reduction in this context and what will the effect be on livestock keepers (It should be noted that for many livestock keepers, livestock is just one of their many different livelihood activities)?

Dorward (2000) argues that widespread rural poverty reduction requires the tightening of rural labour markets. This may be achieved through either tightening urban labour markets that draw in rural labour, growth in tradable rural productivity that draws in labour, or growth in productivity for staple non-tradables, leading to an increase in real wages. Higher rural wages would then have a 'spin-off' or 'multiplier' effect that would lead to increased demands for local non-tradable goods and services, creating further jobs. Livestock would contribute to poverty reduction, particularly through increases in the demand for livestock products. The income elasticity of demand of livestock products is typically high in developing countries which means that as incomes rise,

demand for animal products increase, which can have a positive outcome for producers. Schuh (2000) states that technical improvements, that simultaneously raise agricultural productivity, increase the income of the rural poor and lower food prices, have great scope for reducing the overall incidence of poverty.

However, concerns have been raised as to whether poor producers will really be able to harness the benefits and meet market challenges. Smallholders are generally 'remote' in terms of their limited access to inputs, supplies, markets, information and technology. They incur high costs of transportation and face inadequate infrastructure. Delgado, Nicholson and Staal (1997) applied insights from New Institutional Economics to the study of livestock marketing amongst smallholders. They state that in Africa, dairy sector farmers experience high transaction costs for both production and marketing of products such as the cost of searching for a buyer, screening potential trading partners, transferring the product, monitoring and enforcing the agreement. Transaction costs increase with distance at a faster rate than transportation costs alone due to the increased costs of information and the spoilage that often occurs before a buyer is found. Smaller producers also appear to receive lower prices than larger producers in some marketing channels. Thus, access is limited and high transactions costs are incurred which limits market involvement.

The poor are less likely to be able to access consumers. The commercialisation process will not be 'frictionless' and equity and environmental considerations must be considered. It has been suggested therefore that, if the marketing and income generation of livestock production is to be a driving policy goal, then policies should aim to reduce 'remoteness' and connect people to market through infrastructure construction and transport initiatives.

## Methodology

Current methodologies applied to the livestock sector reflect prevalent 'livestock production' goals. The focus here is wider and encompasses how livestock can improve the wellbeing of livestock keepers, rather than concentrating on livestock alone. As Roeleveld (1996) recognises, "it is clear that understanding the livestock system requires more than knowledge of livestock alone". It is pertinent to explore methodological frameworks (past and present) that encompass the wider perspective and multiple functions of livestock.

Livestock development research has traditionally been conducted on a single disciplinary basis. Economic theories have applied neo-classical models, herd models and budgeting to livestock production. In a recent analysis, household economic models have been applied to the study of livestock innovations (see Birner, 1999). Anthropological studies have traditionally described the social organisation of livestock husbandry systems with few practical applications.

Farming Systems Research (FSR) marked the first multidisciplinary framework to be applied to livestock development. It takes a more comprehensive 'systems' view of mixed production systems and "looks at the interactions (both social and biological) taking place within the whole farm setting" (Shaner et al., 1981, cited in McCorkle, 1992). It became increasingly apparent that knowledge of the genetic make-up of livestock and the biophysical conditions were not enough, and that socio-economic and institutional conditions needed to be understood as well (Roeleveld and Van Den Broek, 1996). This is reflected in the experience of tropical Latin American countries where the main constraint to livestock development has been found to be conceptual rather than technical. Animal scientists, are often ignorant of practical problems and unaware of the broader picture systems context, sustainability issues and current social concerns (Vaccaro, 1997).

However, in terms of technology transfer projects, FSR has been criticised (see Hunt, 1991) as being insensitive to farmers, as technical information and advice is given one way, rather than facilitating farmer-researcher shared learning. FSR has rarely considered gender implications, and has a male-bias. Furthermore, Biggs (1994) states that the result of many FSR programmes has been disappointing due to the limited extent to which feedback has been included in the research process.

Veterinary studies have focused on the health aspects of livestock production, and the realisation of the importance of local conceptions of animal health led to the development of ethnoveterinary research in the 1970s. Hess, in an interesting study concerned with sheep

rearing in Ecuador, demonstrated how it was not until the vets began to take account of local understandings that people began to respond to the vets' advice (Hess, 1997).

Participatory Rural Appraisal (PRA) emerged in the 1980s in response to dissatisfaction with the apparent wholesale transfer of technology of certain research technologies into situations where they were inappropriate (Amaryta and Loader, 1999). Temu and Due (2000) recommend that PRA techniques should be incorporated in more projects given that they are time-saving, cheaper, produce higher quality information and encourage stakeholder involvement as compared to sample surveys. PRA techniques (mapping, transect walks, activity/resource calendars, historical matrices, wellbeing ranking) for agriculture are well documented elsewhere (Chambers, 1980 & 1983; Kumar, 1993; Waters-Bayer and Bayer, 1994; Freudenberger and Freudenberger, 1994; Sims, Feldstein and Jiggins, 1994).

However, participatory methodologies are less developed for livestock than for the crop sector. In 1994, RRA Notes contributed to the literature of PRA and livestock, with a special edition, which provides case studies of livestock projects where PRA has been adapted. The case studies cover aspects such as animal health, animal production, and socio-economic dimensions of gender and wellbeing ranking. Participatory Technology Development (PTD) has been developed to facilitate a process of technology experimentation (see below).

A more recent methodological development has been the Sustainable Livelihoods model, which has been developed to assist the planning of development activities and to assess the contributions made by interventions to livelihood improvements. At the centre of the model are people and their access to resources (natural, social, human, financial and physical). The micro- (people and resources) are linked to the macro- in terms of how 'external' factors such as government, the private sector, laws, policies affect people's access to resources and livelihood strategies. The 'vulnerability context' is included in terms of 'shocks' (economic, natural, physical and social), trends, and seasonality, which affects access to resources and decision-making. The framework can be used as a 'checklist', focusing on one livelihood activity (livestock in this case) and its relations and interaction with other micro- and macro- aspects (see for example Anderson, Drucker and Clarke, 2000).

**From Transfer of Technology to Participatory Technology Development**

In development projects, the conventional transfer of technology approach has been criticised for poor results, and in some cases upsetting the old methods of land use (eds.: Haverkort, Vand der Kamp and Waters-Bayer, 1991). In such programmes, outsiders have introduced (often-

inappropriate) technologies to farmers. The role of farmers in developing technologies has been underestimated and under utilised (ibid.).

Participatory Technology Development (PTD) has been devised by researchers to support farmers in order to increase their capacity to manage change in their farming systems. The outcome is two-fold: locally adapted improved technologies, and improved experimental capacities of farmers (eds.: Haverjort, Vand der Kamp and Waters-Bayer, 1991). There are a number of strengths and weakness with farmers experiments. Some strengths of farmers experiments are that the subjects are chosen by and relevant to farmers; they start with farmers own knowledge and expand and deepen that knowledge and they use criteria which are directly related to the local values, for example those related to taste and utilisation. Farmer's experiments also have their methodological limits. For example, the search for improved technologies can be based on limited scientific understanding of the processes involved; farmers may have the tendency to use a technology over their whole field, and not use a 'control'; farmers may attribute crop performance to one obvious factor and not see other intervening effects or that certain factors may be interrelated, and communication of results may be limited to certain geographical areas, gender and/or socio-economic categories (ibid.). Examples of PTD can be found in (eds.: van Veldhuizen, Waters-Bayer, Ramirez, Johnson and Thompson, 1997; and Haverkort et al., 1991).

## 1.4 CONCLUSIONS

The analysis presented has shown that technology interventions in the past have been inappropriate to the needs and objectives of livestock-keepers. In order to develop appropriate technology it is argued that more in-depth analysis of the livelihood context and how it constraints or facilitates innovations is needed.

The understanding of the often multiple objectives of households and decision-making rationale are key to such analysis. When considering innovations, households often make trade-offs between income and security objectives. A vital question is the function which livestock at present contribute to households, and poverty reduction. Livestock can perform a number of different functions and it is important to identify these roles, and if feasible, strengthen them. The general premise is to build upon the resources and their uses which households have and acknowledge other functions, apart from income and food functions that livestock play. In this way, livestock development can contribute to the improved wellbeing of people, within the context of their livelihood system.

# 2. RURAL LIVELIHOODS IN THE YUCATAN AND CAMPECHE: GENERAL DESCRIPTION

## 2.1 INTRODUCTION

This paper reviews general features of people's livelihoods in the four villages where the project worked. This provides a context for understanding peoples' livelihoods and poverty, the role of crops and livestock in their livelihoods, and the aspirations, resources and constraints affecting their adoption and adaptation of different crop and livestock innovations.

We begin with an overview of the main historical changes affecting the area and its people. We then go on to discuss in more detail their livelihood assets and activities, and the policies, institutions and processes affecting access to and productivity of assets and activities.

## 2.2 CHANGES AFFECTING RURAL PEOPLE IN THE YUCATAN PENINSULAR

In 1995, the total population of the States of Yucatan and Campeche was approximately 2.2 million people, of whom between 400,000 and 500,000 live in rural areas. While the overall population of the two states increased by 180 percent from 1960 to 1995 (an annual growth rate of 3 percent), the rural population increased by approximately 50 percent (an annual growth rate of just below 1 percent)[1]. Approximately half of the population belong to the indigenous group, the Maya. Their language and customs are predominant in rural areas, especially in the more remote areas in the south and centre of the Peninsular.

Statistics on the number of poor people in rural Yucatan are not available, but in Mexico as a whole, campesino farmers have been largely bypassed by recent economic growth. In the villages where the project worked, campesinos' themselves described 50 to 90 percent of households as poor or very poor. Results from village surveys in the area suggest that about 40 percent of villagers considered themselves to be worse off in the late 1990s than they would have been 50 or so years ago. Between 30 and 50 percent considered themselves somewhat better off. Perceptions of improving wellbeing were associated with increasing opportunities for advancement and improved services (electricity, water, health, transport and shops). Perceptions of declining wellbeing were associated with current increased market involvement and vulnerability to rising prices and with reduced incomes and food security. Whilst in the

past, there was less reliance on the government, and greater access to and productivity of natural resources. These perceptions reflect campesinos' continuing reliance on agriculture and pressures on agricultural land, combined with increasing involvement in the market economy.

These changes will now be explored within the context of major historical events and processes affecting rural life in Yucatan and Campeche.

Table 5 summarises major changes in state policies and services, institutions, economic condition, and population pressure affecting rural people in Yucatan and in other parts of Mexico.

**Table 5. Major historical events and processes affecting rural Yucatan**

| Date | Changes | Effects |
|---|---|---|
| 1540s | Spanish conquest | Destruction of Mayan society.<br>Alienation of land and other rights |
| 1821 | Mexican Independence | Mexico established as a Republic, gained independence from Spain |
| 1847 | War of the Castes in the Yucatan Peninsular | Mayans failed attempt to gain independence from the rest of Mexico and white oppression |
| 1910, 1915 | Revolution and land reform | Establishment of ejidos |
| 1960's, & 70's | Interventionist and import substitution policies, oil boom in 70's | Guaranteed prices, state marketing boards |
| 1982, 1985, 1986 | Oil price fall, Mexico City earthquake, oil price fall, GATT accession | Devaluation, inflation, recession |
| Late 1980's | Structural reform, market oriented policies | Reduced agricultural and rural services, modest national growth, increasing differentiation |
| 1989-onwards | Agricultural policy reform | Privatisation of marketing and processing industries.<br>Replacement of price and income support subsidies and protection by direct payments to farmers.<br>Collapse of hennequen industry (1992) |
| 1992 | Agrarian land reform | Enabled ejido members to privatise, rent, mortgage lands |
| 1994 | Foreign exchange / debt crisis | Devaluation, inflation, recession, unemployment |
| Continuing processes | Population growth not balanced by rural out migration | Increased rural population density, increasing pressure on traditional milpa system |

[1] Calculated from INEGI (1960 and 1995). There is some controversy as to the recent rate of population growth - official statisics suggest 1.8% in 1998 whilst academic research indicates between 2.7% and 2.9% (Moya 1999).

## The Spanish conquest

A century prior to the Spanish conquest in the 16th century the Maya cities of the Yucatan lay in ruins. The Yucatan was inhabited by a somewhat diminished Maya population when the Spaniards arrived. It was to be reduced even further at the hands of the diseases the Spaniards brought with them to the New Spain (Ruiz 1992). The Spanish conquest also destroyed part of Mayan culture and society. However, much of their culture proved resilient. For example, their agricultural economy was, and continues to be, based on the milpa system, with maize, beans and squash as the main crops. The milpa system involves a slash and burn technique whereby forest areas are cleared, crops are sown and cultivated for a number of years and then the land is left fallow for an extended period to recuperate. In this way, the nitrogen-reducing effects of burning the forest are mitigated. Long cycles for forest regeneration and extensive primary forest also supported hunting and collection of wild forest products. The Spanish also introduced iron tools, which facilitated the cultivation of the milpa. They also introduced domestic animals such as pigs, cattle, sheep and donkeys, which became their staple source of meat instead of hunted animals and provided animals for transportation. From the beginning of the conquest, land was expropriated for *Haciendas,* large land holdings, and the indigenous peoples were displaced or employed as peons, consequently less land was available for the Maya to farm.

## Agrarian law and land tenure

In 1910, the Mexican Revolution brought about the Agrarian Law of 1915, which in theory redistributed land amongst campesinos and became a part of the Mexican Constitution of 1917. Article 27 of the constitution encapsulates the land reform provisions, which gives the state the authority to regulate private property and the use of natural resources. The state is also responsible for guaranteing the equitable distribution of the national wealth and its conservation. Article 27 calls for the sub-division but not the total disappearance of large property. The land was to be bought, each state determined the maximum size of private property, *hacendados* had to divest themselves of the excess lands and the buyer could not sell his lands for 20 years. Certain types of landless communities or those with insufficient lands had the right to ask for land to be taken from adjoining haciendas, if the *hacendados* refused to sell the state had the right to expropriate them. Given the political influence of the *hacendados,* it is not surprising that the laws regulating the implementation of this section of Article 27 did not come into action until 1923. By 1983, some 3 percent of land barons owned 83 percent of all rural property, safe from expropriation (Ruiz, 1992).

Within the Agrarian Law, the main features were the official establishment of the *ejido* as a communal agrarian system for campesinos and the establishment of maximum limits to land use under private ownership (to prevent the resurgence of dominant power structures). In order to have access to the land a campesino had to be a member of the community. In addition, individual parcels could not be sold or rented. Although land could be inherited, it remained the property of the nation. The extent of the reforms is demonstrated by the fact that approximately half of the land area of Mexico and 3.5 million people were effected by the reforms. Nevertheless, the most productive agricultural land areas remained in the hands of the elite (Ruiz 1992).

The ejido system remained largely unchanged throughout rural Mexico until, in 1992, the Mexican Government enacted an Agrarian Reform in response to growing population pressures and the growing scarcity of arable land. Individuals were given increased rights to their lands and commercial associations were allowed. Increasing population density and concurrent declining agro-ecological conditions meant that areas farmed were of two hectares or less (in the private and *ejido* systems) and incurred low productivity levels[2]. Under the ejido system, certain restrictions were placed on farmers. They could not acquire more land by law. Therefore the scale of production was limited, the formation of associations of small farmers was inhibited, the flow of capital was restricted as laws curtailed the rent, transfer or sharecropping of land and the formation of commercial associations, and as communal land, it was not recognised as collateral and as such bank loans were unattainable. Such insecurities and the low level of productivity motivated the government to modify the reforms.

Under the 1992 reform, the *ejido* land is divided into two categories, common use and parcelled plots. Land for common use cannot be transferred to other individuals but it can be used in productive associations. The local ejido assembly decides what to do with the common land. In terms of parcelled plots, the individual ejidatorio has the permanent right to use the parcel of land, although the parcelled land is property of the ejido. The individual is able to rent the land for up to thirty years, and sell the land to other ejido members. Furthermore, the separation of parcelled land can be authorised by the ejido assembly, and individuals can then become private property owners. If the ejido parcel is converted into private property, the former ejido member

[2] As discussed earlier Yucatan and Campeche have experienced an increase in rural population of approximately 50% from 1960 to 1995. This has led to increasing limits to agricultural production due to lack of available land for cultivation, with reduced individual access to land and a shorter fallow period (see sub-section 2.4).

can sell or rent it to persons outside of the ejido, or use it as a mortgage for other types of private property.

An agency (the Procuradoria Agraria or Agrarian Procurement Office) was set up to provide legal advice to ejidatorios. The award of property titles and establishment of limits of individual parcels is administered under PROCEDE: Programa de Certificación de Derechos Ejidales y Titulaciones de Solares Urbanos, the programme for Certification of Ejido Rights. In addition, Agrarian Courts have been created to settle disputes concerning land tenure, giving security to land ownership.

## Economic liberalisation

It is useful to view the Agrarian reform of 1992, as part of a much broader set of measures introduced from the mid-1980s onwards. These measures were intended to liberalise the Mexican economy, in response to previous policies and conditions, which followed.

From the 1940s, successive Mexican governments implemented a policy of import substitution by providing incentives to industry, preferential access to funding, public expenditure on infrastructure, economic regulation and direct intervention, which guaranteed demand through import controls. In the agricultural sector, production was promoted through investment in irrigation infrastructure and a pricing policy. The aim was to improve Mexico's agricultural productivity, self-sufficiency, reduce the level of imports, and contribute to the flow of foreign currency and employment creation, through agricultural policy.

The import substitution policy was sustained predominantly by an oil boom, which occurred before 1982 (OECD 1995). However, with the fall in oil prices in 1982, the country emerged with high debts. The Mexican peso was highly devalued and a large increase in inflation occurred – from approximately 25 percent in 1981 to over 100 percent in 1982. In 1982 the deficit stood at Mex. $187,302 million, equivalent to 34.3 percent of GDP (CIESTAAM 1997). The debt crisis brought the country into a recession and GDP fell by 4 percent in 1983. The Government, began to focus upon a more neo-liberal market-oriented policy, with structural economic reforms and policies, including the privatisation of state-owned enterprises, a more liberalised trading regime and, pertinent to this study, the deregulation of the agri-food sector. The change to a market-oriented approach coincided with the accession to the GATT in 1986, joining of the OECD in 1992-3 and NAFTA in 1994.

However, the economy has since experienced a number of economic crises. In 1985 and 1986 two external shocks hindered the adjustment process – an earthquake in Mexico City in 1985, which called for high emergency spending, and a reduction in oil prices by approximately 50 percent which diminished foreign exchange earnings. Inflation rose to 159 percent in 1987, and output fell by nearly 4 percent in 1986. In response, in December 1987 a stabilisation programme, Pacto, was agreed in order to achieve economic growth through the stabilisation of key variables such as inflation. Controls were set on wages, exchange rates, and the price of the 'basic basket' of goods and services. Inflation fell to 20 percent in 1989 and the economy grew by 2 percent in 1987. National economic growth rates continued to be positive until political instability occurred in 1994, when the assassination of the leading candidate in presidential elections triggered outflows of capital from the country and exchange rate commitments became unsustainable. Consequently, the authorities abandoned exchange rate controls. The peso was then floated until it found its own level at Mex. $8 to the US dollar. Inflation rose again to around 50 percent, and the economy contracted by approximately 7 percent. Over 1.5 million people became unemployed. The cost of the devaluation is estimated to have been approximately Mex. $300,000 million, 15 percent of GDP (CIESTAAM 1997).

From 1995 onwards the market-oriented model persisted in its aim to repay the external debt, combat inflation, and promote domestic saving (agriculture sector measures are explained in sub-section 2.4). Problems of high external debts, the tendency of overvaluation, low investment levels, and reduced consumer demand continued. By 1996, however, production started growing again, and due to the government's austerity measures, raising of capital in the private markets and the growth of exports from NAFTA, economic growth resumed, foreign investment revived, and unemployment fell.

## Agricultural Policies

Throughout this period agriculture has remained a significant sector in the Mexican economy in terms of employment, output and trade, and has continued to be a major component of the livelihood strategies of rural people. However, it has suffered from a prolonged crisis, which in the case of grains, started in the 1960s. This has been aggravated by the economic crisis of 1995/6 and, in Yucatan, by a drought in 1996.

During the period of 1989-1994, Mexico embarked on an ambitious and radical programme to reform agricultural policy aimed at efficiency in resource use, better policy targeting, less domestic regulation and trade liberalisation. Structural change took place, including the privatisation of state-owned agricultural marketing and processing industries. There has also

been a notable shift away from production-linked price and income support policies (generally complemented by trade measures) towards direct payments to farmers.

In 1989, the government decided to progressively remove guaranteed prices, import barriers and consumer price ceilings for grains, beans and oilseeds. These actions were taken in the belief that guaranteed prices set at the same level in all parts of the country impeded diversification of production, market-orientation, high-quality production and the development of private distribution channels. However, structural-marketing impediments inhibited development of private-sector incentive structures. To rectify this, ASERCA was created to promote the development of private agricultural markets for all agricultural products, and, pertinent to this study, CONASUPO maintained its role for maize, beans and milk powder until 1999[3].

Reforms in pig meat markets involved first (in 1988) the replacement of import permits by a 20 percent tariff, due to be phased out by 2003. Government control of retail prices was phased out in 1992. Poultry meat-product prices had been supported by import restrictions (permits) and a 10 percent tariff, but following membership of NAFTA, a duty-free quota was granted on imports.

Input markets were also affected by the reforms. In the 1980s, fertiliser had been heavily subsidised. Subsidies were reduced in the early 1990s and FERTIMEX, which had been the sole supplier of fertilisers at low prices, was privatised in 1992. Domestic production and distribution of ammonia is entirely controlled by the state oil firm Mexican Petroleum (PEMEX). Similarly, the National Seed Production Company, PRONASE (created in the 1970s to provide Mexican farmers with certified and low cost seeds for maize, beans, rice and oilseeds) lost its special status in 1992 and now competes directly with the private sector.

To address the pressures facing the agricultural sector, the current government administration (1995-2000) has developed a set of policies known as the *Alianza para el Campo.* This includes a set of measures with the following objectives:

- raise producers' income
- obtain self-sufficiency in foodstuffs

[3] Until 1989 CONASUPO, Mexico's public marketing board, purchased much of domestic production of 12 crops and acted as one of the importers of these commodities. It was responsible for storage, transport, processing and retailing of these commodities. It also granted a marketing subsidy to ejidatorios producing maize and beans in non-irrigated areas to help them transport and sell crops through PACE (A Programme to Support the Marketing in Ejido Produce). In 1990, in line with the privatisation of state companies, CONASUPO reduced its market intervention activities. However, it continued to act as a buyer of last resort for maize and beans (key staple foods), through a price support scheme, until the end of 1999, in line with free trade objectives.

- reach a balance in agricultural trade
- increase agricultural production at a rate higher than population growth
- reduce regional differences in productivity, employment and income
- contribute to poverty alleviation.

The *Alianza para el Campo* consists of 22 programmes. However, it has been criticised as 'elitist' as access to most programmes is limited to those who have sufficient resources, viable projects and are well organised. The majority of programmes are not directly relevant to campesinos in Yucatan and Campeche. An exception to this is a programme of Direct Payments to the Countryside, *Programa Para el Campo* (PROCAMPO). PROCAMPO allowed a shift from previous commodity price support schemes (for maize, beans, and oilseeds for example) to direct payments and liberalisation of commodity markets (Mex. $708/hectare in 1999). The programme is to be maintained until 2012, with payments compensating producers for income losses due to reduced (international) prices for maize and beans. There has been some criticism of the scheme, as payments have not risen in line with inflation.

A more recent policy effecting campesinos in Yucatan and Campeche is referred to as *Rosa Tumba Pica*. This was initiated in May 1999 by the SAGAR (Mexico's federal agriculture ministry) and aims to eliminate the burning of plots, traditionally used by the campesinos within the slash and burn system. Assistance is provided in the form of a package comprising inputs of herbicide, seeds and fertiliser of which 50 percent is subsidised, and a payment of 448 pesos per hectare (1999). Rosa Tumba Pica can be received simultaneously with PROCAMPO. The programme is due to finish in 2010.

In general, past and present agricultural policies have focused on the modernisation of agricultural practices, aimed towards the commercial sector. Neo-liberal market policies have concentrated on guaranteed prices for basic grains and low investment in small-scale rural producers. A small proportion of farmers has benefited from government subsidies (de Janvry, Sadoulet and de Anda, 1995). Credits, agricultural inputs and extension services have been targeted to producers with fertile soil, irrigation, infrastructure and technology. Agricultural reforms since 1990 have exacerbated the situation, with reduced spending on small-scale agriculture, thus widening the gap between modernised agriculture and the campesino sector.

## Broader rural development programmes

The government also implements broader rural development programmes to address problems faced by rural communities. Several of these operate within the Peninsular to develop infrastructure, education, health, electricity, water, and capacity building.

In 1989, PRONASOL, a National Solidarity Programme was established to carry out poverty alleviation work in generally rural areas. In 1992, PRONASOL was attached to the Secretariat for Social Development (SEDESOL). Its main objectives being the promotion of community initiatives through a bottom-up approach, and the creation of new links between communities and the government, in order to carry out policies for poverty alleviation. It was implemented along three main lines: supply of basic infrastructure (eg. housing, electrification and roads), social welfare (eg. health, education and nutrition) and support to productive activities including agricultural production. Poor communities and poor urban areas have participated in PRONASOL programmes through the formation of Solidarity Committees, which determine the projects to be carried out, and through the Municipal Council [4], which decides upon priority areas.

Since 1995, PRONASOL has operated under the Poverty Alleviation Programme, which places greater emphasis on the better targeting of financial assistance. Several funds and programmes have been established to address poverty issues and promote social development. The National Fund to Support Enterprises in Solidarity (FONAES) was established in 1991 to stimulate the economy in the poorer regions of the country through financial support to productive enterprises. Activities supported have included agriculture, forestry, rural industry, extractive and small businesses.

A number of other institutions work in rural development. The Secretariat of Transport and Communications (SCT) is responsible for building roads in rural areas and the Federal Commission for Electricity (CFE) supervises rural electrification. The National Institute for Indigenous Communities (INI) is promoting welfare of indigenous communities and supports educational services, organisational and social capacity-building and cultural promotion. The Water Commission, with World Bank Assistance, has implemented a programme for the Humid Tropics since the mid-1980s and has contributed to road construction and rehabilitation of land in rural areas. ¨Progresa¨ is an educational grant, administered at the federal level and is financial assistance awarded to primary school children within low-income households.

Civil society organisations have also emerged in response to the top-down approaches administered by many development organisations (Guendel, 1998). NGOs dedicated to

[4] Each state in Mexico is divided into municipalities (there are 2394 municipalities in the 31 states). The municipal authority and municipal council are elected, the latter being composed of representatives of the urban or rural communities and chaired by the President of the Municipality. Each village has a Comisario, a political representative who then operates at the municipal level, and an *ejido* authority, which is president of the committee over the management of state-owned *ejido* land.

research and development in the Yucatan and Campeche are involved in a wide range of activities such as agroforestry, horticulture, conservation, nutrition and production marketing.

## 2.3 LiVELIHOOD OUTCOMES AND ACTIVITIES

### Continuing poverty

Rural development programmes and periods of overall economic growth have failed to prevent income distribution in Mexico becoming further polarised in recent years. Although Mexico's GDP is ranked as fourteenth highest amongst the OECD countries, the per capita figure is approximately a third of the average (OECD 1995). It was calculated in the mid-1980s that almost 60 percent of the population were poor and just under 35 percent were living in conditions of extreme poverty (ibid.). Since then liberalisation policies appear to have benefited the medium and high-level income households to the detriment of the poorer sectors of the population in both urban and rural areas. Measured by the Gini co-efficient, income equality increased from .450 to .475 between 1984 and 1992 (OECD 1995). In 1986, those in the highest income decile were 36 times richer than the lowest income decile (ibid.).

Poverty has also increased nationally in recent years. The minimum salary in 1997 stood at Mex. $26.45 per day whilst the price of the basic daily basket of consumer goods was Mex. $82.93. The work time needed to acquire the basic basket was 8.4 hours (under the minimum salary) in 1986, 17.6 hours in 1994 and 25.1 hours in 1997 (CIEMSTAAT 1997). In 1995, only 2 percent of the population were earning a salary of between two and ten times the minimum salary. The size of the informal sector is said to have increased in recent years, and in 1994 was estimated at approximately 20 percent (OECD 1995). Of the total workforce, 47 percent do not have social security (ibid.).

These national statistics show a continuing poverty that is clearly observed amongst campesinos working with the project, as discussed earlier. Agricultural productivity has decreased, with declining yields from the milpa system. Generally, this has not been offset by the introduction of new crops or technologies, or by expansions in export crops, capital intensive crops or livestock production systems as encouraged by government programmes, or by economic liberalisation. Such changes have largely benefited commercial farms. The benefits of change have largely by-passed campesinos, and many continue to eke a living from a complex but precarious and variable patchwork of agricultural and non-agricultural activities.

## Livelihood activities

As indicated earlier, the current livelihood strategies of campesinos in Yucatan are a complex mix of activities. These have evolved over time as campesinos' opportunities, resources and environment have changed, and as they have adapted their activities to try to meet their needs and aspirations. Changes discussed in sub-section 2.2 have effected campesino activities in different ways, but it is remarkable how many of their basic activities (crop production, handicrafts, hunting and gathering) continue to be built on traditional pre-conquest Mayan activities. However, the ways that they are done and socio-economic context, organisation and returns have changed dramatically.

Table 6 below summarises the main livelihood activities engaged in by campesino households, their resource needs, products and livelihood functions. This is followed by a brief description of the main features of each activity, with a more detailed description of the assets base that supports these activities. Differences between men and women as regards responsibility for and involvement in these different activities are discussed in sub-section 4.5.

**Table 6. Main activities in campesino livelihoods**

| Activity | Resource needs | Products | Livelihood Function |
|---|---|---|---|
| Crop production: Milpa or Mechanised cultivation (mechanisado) | Land, labour, seed, fertiliser/ chemical inputs | Maize | Own consumption, storage of value, means of exchange, sales |
| | | Beans | Own consumption, sales |
| | | Squash | Own consumption, sales |
| | | Sweet potato | Own consumption, sales |
| Horticulture: Solar or backyard. | Land, labour, seed, compost | Fruits | Own consumption |
| | | Vegetables | Own consumption |
| | | Forage | Animal feed |
| Animal-rearing | Animals, feed (maize, forage), labour | Chickens | Own consumption, occasional sales (poorer h-holds) |
| | | Pigs | Sales, means of saving |
| | | Steers | Sales, means of saving |
| Bee-keeping | Hives, equipment, forest, labour | Honey | Mainly sales |
| Wood collection | Forest, labour | Wood | Fuel-wood<br>Construction<br>Rarely for sale |
| Hunting | Forest, labour | Game | Consumption<br>Sales |
| Household activities | Labour | Clean household, clean clothes, food | Social reproduction |
| Sewing, embroidery, | Labour, materials | Traditional dresses | Own use, occasional sales |

| | | | |
|---|---|---|---|
| hammock-making | | Hammocks | Mainly own use |
| Wage Labour | Labour, sometimes transport | Income | Income generation |

**Crop production**

Campesinos agriculture in the region can be described as a synergistic husbandry of three or four agro-ecosystems: secondary vegetation (including the milpa), the forest, the permanent cropping area, and the home garden (Anderson, Keane, Moguel and Trejo, 1998). Present day campesino agriculture comprises traditional Mayan components such as the milpa and the solar or home garden, combined with introduced elements such as horticultural crops (tomatoes, chillies, sweet-peppers) and mechanised production of maize.

The importance of maize is illustrated by the extent of land devoted to it. In Campeche, 70 percent of agricultural land (210,996 hectares) was dedicated to maize, although in Yucatan maize occupied only 19 percent of agricultural land (162,287 hectares), in 1997/8. Yucatan with its stony soils is less suitable for the production of maize than Campeche. Maize accounted for 36 percent of the total value of agricultural production, in 1997/8 in Campeche and 9 percent during the same period in the Yucatan.

Nationally, approximately 42 percent of maize producers are subsistence farmers, producers retain approximately one third of their production for their own consumption and livestock feed requirements. This proportion is much higher among campesino farmers. Most production is of white maize (95 percent), and yellow maize is mainly imported to use for animal feed and starch production though it has been used for human consumption.

**Traditional Milpa**

As already mentioned, the milpa uses a slash and burn system which consists of primarily weeding and cutting hedges, then slashing the larger trees and burning the plot in order to clear the land for sowing (Aguilar, 1990). The activities that follow are, weeding, application of herbicide, insecticide, fungicide and fertiliser. Harvesting of crops then takes place and the maize plants' stems are then bent over to allow the maize cobs to dry. In subsequent years of plot cultivation, land is prepared by slashing and burning any tree re-growth, before sowing. The main crop is maize, but in addition beans, squash, chillies, sweet peppers and watermelon may be sown. The soils are variable and may be rendzinas or litosols. The period of utilisation is now two years followed by a fallow period. As discussed previously, pressure on available land is leading to shorter fallow periods, giving rise to lower soil fertility, low yields and weed infestation.

**Minimum Tillage System**

The minimum tillage or *labranza minima* is a sedentary system of production which consists of a rotation of the soil in continuous or individual form. The continuous minimum tillage system is carried out in furrows of 20-30cm width, and similar depth is rotated and cultivated. The land between the furrows is not tilled, but the weeds are kept low. The distance between the furrows depends on which crops are to be sown. In the individual minimum tillage plants are sown into 20-30 cm deep holes. This system is used to cultivate cassava, sweet potato, chilli, and tomatoes. This is practised in luvisol soils.

**Mechanised**

The land is worked in a conventional form with relatively higher production levels than in the other systems mentioned. The forest is cut-down, trees are then burnt and the roots are uprooted by tractor. The land is levelled, soil is prepared with a disk harrow and plough and seeds are sown by a machine and tractor. Insecticides, fungicides and herbicides are then applied with a sprinkler. Weeding takes place manually as does harvesting. For subsequent agricultural cycles, a similar process takes place though only re-growth needs to be slashed and burned, thus there is less work and less costs. The main soils are litosol and luvisol. Where this system exists, and it does not exist in all villages, campesinos partially or completely use the mechanised system.

**Roza Tumba Pica.**

This is a new system of production promoted by SAGAR at the national level with the aim of reducing the burning and deforestation of areas. It also aims to help prevent the spread of fires from one plot to another during the burning period. The payment is dependent on the size of forest area that the campesinos leave. In order to provide incentives to adopt the system the government is providing agricultural inputs of improved seed varieties, fertiliser and payments of Mex. $450 per hectare per year to those who participate. It is carried out in dry areas.

**Horticulture**

The solar or home garden is an important part of the campesino livelihood system. This is an enclosed area around the house, where fruit trees and some vegetables are grown and pigs and chickens are reared. Ka'anché, seedbeds on stilts to keep away chicks, are also kept within the solar. Products are generally for home consumption.

Table 7 shows the activities undertaken by one household during 1998, in mechanised, milpa, and horticulture systems. In addition, it provides a specific insight into the different male, female activities, which will be expanded on in chapter three.

**Table 7. Production Calendar for 1998 for Household in X'culoc, Campeche**

| | Jan | Feb | March | April | May | June | July | Aug | Sept | Oct* | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mechanised | Harvest - M | Harvest - M | Burn - M Plough -rented tractor | | Plant - M, F, C | Fertiliser - M, F Herbicide - F, C | | | | | | Harvest - M (+ 2 hired) |
| Milpa | Slash and burn - M | Slash - M | Burn - M | | Plant - M, F, C | | | | | Harvest - M | | |
| Honey | Harvest - M | Harvest - M | Largest Harvest - M | Harvest - M | | | | | | Hives - M | | |
| Vegetables | | Harvest - M, F, C | | | | | | | | | | Plant - F |
| Sweet Potato | | Harvest - M, F, C | | | | | Plant - M | | | | | |
| Squash** | | | | | Plant - M, F, C | | | | | | | |
| Mucuna | | Harvest - M, C | | | | Plant - M | | | | | | |

*M*= male; *F* = female; *C* = children

*Harvest began in October for home consumption. The main harvest had been delayed due to rains.

** Did not produce

*Source:* PRA technique carried out in Feb 1998

**Animal rearing**

Nationally, 40 percent of pig-meat production is attributed to backyard production or small producers, 30 percent to vertically integrated firms and the remaining 30 percent to medium-sized farms and producers' associations. Approximately 8 percent of production occurs in the Yucatan. Within Campeche approximately 53 percent of households who rear animals have pigs, in the Yucatan the number is slightly lower at 47 percent (INEGI 1991).

Within the study area, the majority of households have poultry and pigs, which are reared in the solar. Management techniques vary within different households. Poultry rearing tends to be the responsibility of women while the pigs are the responsibility of men and women (this varies in different villages). Poultry roam freely within the solar, and are usually sheltered in a small stone hatch (*hactun)* at night. Some households have constructed hen houses in recent years (largely due to external intervention) in an attempt to facilitate egg collection, protect poultry from theft and prevent illnesses (for example, exposure to wet conditions can increase the susceptibility of poultry to avian influenza). Within some households, poultry may be kept within the hen house at all times. In others, they are let out to scavenge in the solar for a number of hours each day. Poultry are traditionally fed milled maize or masa and may scavenge within the solar. In some households, they are fed forage. Predominant illnesses are colds, diarrhoea and parasites. Illnesses are generally treated with local remedies and small doses of human medicine. An undiagnosed illness is prevalent in the area, which occurs approximately every 8-10 years with devastating effects, in some cases wiping out the household poultry population.

Creole and crossbred pigs are reared in the area. They are largely free-range within the solar, though some may be tied up in order to speed the fattening process, prevent them entering the house and reduce possibility of theft. In addition, some households have constructed pigpens in recent years in order to increase productivity, reduce damage to the solar and prevent illnesses. Treatment of pig illnesses is also based on local remedies. However, a visit to the local veterinary is obligatory if a large sized pig does not make a speedy recovery with homemade remedies. Pigs are fed maize grain, a maize and water drink, and scavenge in the solar. In some cases, they are fed with forage and Mucuna. Some of the better-off households purchase commercial feeds.

Steers, bulls and cows are reared within the home-gardens, although numbers are kept to one or two, larger herds are kept in pasture areas outside of villages. Larger herds exist in one village

(Xohuayan) where a long tradition in cattle rearing exists and extended families joined forces to maintain pasture and herds together. In another (Sahcabchen), a group of campesinos received credit and assistance to form a cattle-rearing association. The scheme divided the campesinos when management of the steers was complicated by water shortages, the number of participating campesinos is now severely reduced. In X'culoc cattle were only introduced in 1994, using a credit scheme promoted by INI. Cattle are generally purchased on credit within associations formed by governmental organisations, or may be privately owned by the better off households who spend their savings on the animals. They are generally viewed as a form of investment.

The role of different animals in the household livelihood varies. For example, better off households keep chickens primarily for household consumption (of eggs and meat), whilst poorer households keep them for reproduction, sale and consumption. Turkeys are kept primarily for consumption at festivals, although poorer households may sell them. Creole/ crossbreed pigs are kept for sale and consumption. All these livestock scavenge and are also fed maize from the household store. Feeding of grain to pigs and chickens competes with peoples' subsistence demands for maize, but may also be a way of storing value from maize which may deteriorate if stored as grain. The interaction between their regular demands for maize (competing with family demands for maize) and their capacity to provide income at critical times, means that livestock keeping is a critical activity in the livelihood strategies of poorer families. However, patterns of livestock ownership are very complex and sensitive to changing situations of households.

**Bee-keeping**

Beekeeping brings in significant income for some families when the price of honey is good. It is the responsibility of the men. The bees are Apis Mellifera, an Italian bee. Input activities are subsidised approximately 50 percent within Alianza Para el Campo. In Campeche technical support, advice and sales are provided through local groups such as Kabit'ah and the Union de Apicultores Indigenas de Los Chenes. The Yucatecan beekeepers have no such support mechanism and comment that they consequently suffer in terms of husbandry techniques and better access to markets.

**Wood collection and hunting**

Wood, the source of fuel for cooking in the vast majority of households, is generally gathered by men and women. Although it is difficult to ascertain with complete certainty, it would appear the

better off the family is, the less likely it is that the woman will collect fuel-wood. Hunting of animals by the men brings in small amounts of meat to some households.

**Household activities**

Household activities are the exclusive responsibility of women. The workload varies between households according to household composition. Main activities are maize processing (removing maize from cob and taking the maize to be milled), cooking, washing, childrearing, cleaning and feeding and watering animals in the solar.

**Handicrafts**

Traditional handicrafts (mainly sewing, embroidery and hammock making) are important activities among women. Where undertaken for sale they tend to obtain low prices and gain very low returns to labour (Moya 1999).

**Wage labour**

Household members engage in different types of wage labour. Local opportunities are mainly restricted to unskilled agriculture, working on other campesinos' milpas. Many travel out of the village for temporary employment in local towns or further afield (for example in Merida or Cancun) to earn cash to meet specific needs. In the Yucatan the percentage of people who live in a place other than where they are born stands at 6 percent whilst in Campeche it is 26 percent (INEGI 1997). Some people have particular skills (such as plastering) which enable them to gain higher paid work. Some household members migrate to other parts of Mexico or to the United States of America. In recent years, there has been a dramatic increase in the numbers emigrating from certain areas of the region to the USA. These different employment opportunities offer varying salaries. Wages for local agricultural labour range from Mex. $20-30 on a daily basis, whilst building work (for example in Merida or Cancun) pays approximately Mex. $600-1000 per month (Mex. $30-42 per day). The minimum daily wage is Mex. $30 per day (INEGI 1999). In the USA Mexicans from the study area are earning approximately US $6 per hour, or US $900 per month (approximately Mex. $8550).

There appears to have been an increase in both seasonal and longer-term out-migration within the region. The decline in crop yields in recent years and the need for increased income to buy maize (in the case of some households), inputs and other necessities has meant for some households, seasonal employment is a necessary step. In order to pay debts, medical expenses and construct or

repair houses, some have pursued longer-term employment outside of the village. Xohuayan is a notable example of a village where long-term out-migration has taken place; in 1997, 11 men were working in the USA, by the end of 1999 there were 65 men from the village working in the USA.

**Other activities**

The livelihood activities listed above are the most common among campesinos in the study villages. However, there are other activities, which tend to be found among the less poor and better off families. Many households aspire to keeping a shop and a number keep a small shop within their home or engage in petty trading. The more wealthy households may have some form of permanent employment (for example working with an NGO) and/or a larger and better stocked shop, and/or a truck that is used for transporting people and goods in and out of the village.

## 2.4 LIVELIHOOD ASSETS: ACCESS AND PRODUCTIVITY

### Introduction

We now turn to consider the asset base that underpins the various livelihood activities described in the previous section. We consider in turn the different categories of capital identified in the sustainable livelihoods framework: natural, physical, financial, human and social capital. Each is examined in the context of the policies, institutions and processes affecting campesinos' access and use.

### Natural capital

**Land characteristics**

For agricultural production, perhaps the major item of natural capital is land.

The topography of the Yucatan Peninsular is characterised by lowlands with slight elevations and hummocks that peak in the Sierrita de Ticul (275m). It is predominantly a flat, limestone plateau, with elevations in the south-west. The soil was formed from calcareous rocks through which water filters to subterranean deposits and currents. In the highest parts of the lowlands the soils are very rocky and are humid due to the water table. The rocky soils have good permeability and have good water-retention properties. The soils are said to be young and superficial in general and are limited for almost all types of commercial agriculture (Rosales 1988).

In Campeche and Yucatan, the vegetation is principally dry tropical forest. The following is the sub-classification used to describe this forest in Mexico: subcaducifolia forest is part semi-evergreen low in height, during the dry season 75 percent of leaves fall, and part medium and high sub-perrenial, where only 25 percent of leaves fall. Areas of low swampy/flooded forest, savannah, petenes and mangroves are also present (Salvador Flores 1994). Soils are young and shallow, with 42 percent in the Mayan classification of *tzek´el* (rendsinas) or limestone covered with an incipient layer of soil and organic matter in different stages of decomposition. The others are *k´ankab* soils (luvisoles associated with rendzinas). They are localised in the lowest and flattest areas and are soils with medium depth formed by the coluvial decomposition on calcareous material. Perennial and deciduous species develop well within these soils.

The two main soil types are associated with two different types of land use: hand cultivation in milpa land and mechanised cultivation on *mecanisado* land. Rendzine soils are used for milpa cultivation but their rockiness makes them unsuitable for mechanised cultivation. However, luvisol soils have a greater depth, which allows them to be cultivated using tractors and are therefore used for *mecanisado* lands. Luvisol soils become increasingly common as one moves south-west from Yucatan to Campeche, and consequently the frequency of *mecanisado* lands within the cropping patterns tends to increase.

The climate is hot, sub-humid with three variations (AWo, AW1 and BS). An area of type AWo, hot sub-humid with summer rains and a distinctive dry season (canicula), describes most of the state of the Yucatan and the northern part of Campeche where all of the villages lie. In the northern part of the Peninsular, especially in the State of the Yucatan a climatic strip type BS is found, albeit with some variations. This indicates an area of low rainfall and high temperatures. Another sub-type found is that of AW1 with a higher average rainfall, in Campeche from its borders with the state of Quintana Roo to the town of Canchec. In the south of Campeche climate type AW2 is distinguished, hot sub-humid with summer rains, but more humid than others mentioned.

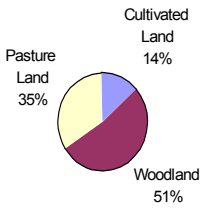
The annual rainfall ranges from 800 mm to 1,200 mm. The rainy season is concentrated between June and October. Generally, rainfall rapidly drains into the sub-soil and rivers are extremely rare in the Peninsula. In Yucatan, there are no rivers and only one lake exists on the frontier with Quintana Roo (Chicnancanab). However, in Yucatan, an abundance of deep wells of permanent water sources, *cenotes*, are prevalent. In Campeche, there are three rivers and a lake, *cenotes* are also found.

The eco-system is very diverse and Flores and Espejel (1994) suggest a classification of 16 vegetation types. Inland areas are sub-tropical with medium and low forests, which are at least reduced if not depleted. Much of the area comprises secondary forests of 4-10 metres high and rich in Leguminosae species. Fauna to be found in the forest areas are; pheasant, foxes, wild pigs, rabbits, armadillo, puma, jaguars, deer, parrots, toucans and a small rat-like animal called tepizcuintle (local species) amongst others. The variety and number of species is said to have decreased due to the deforestation that has taken place (PPDP 1999).

This environmental degradation significantly affects livelihood strategies. As discussed earlier, population growth and associated land availability constraints have led to short fallow periods, and repeated burning within the slash and burn system has resulted in the depletion of soil nutrients. According to a recent study, in 1988 the average fallow length for land cleared and burned for maize production was 12-18 years. In 1996, the fallow period had dropped to 4-6 years. A dramatic and related decline can also be seen in the maize harvest figures, from 975-1300 kg/ha in 1987 to 325-650 kg/ha in 1995 (Guendel 1998).

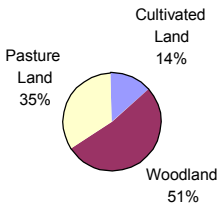
The evolution of land use and decline in availability of forest area is illustrated for Yucatan and Campeche states as a whole in figures 3 and 4 below. They show land-use in terms of cultivated land, woodland and pasture land, within ejidos in both states. The low proportion of woodland within the Yucatan and high proportion of pasture should be noted.

**Fig. 3. Ejido land use in Campeche State**




*Source:* INEGI 1999

**Fig. 4. Ejido land use in Yucatan State**




*Source:* INEGI 1999

Deforestation has also led to a decline in the numbers and varieties of fauna, thereby further restricting hunting opportunities There is also reduced accessibility to wood for fuel and construction purposes.

After land, the major category of natural capital for the campesinos is livestock – chickens, turkeys, pigs, cattle and bees. As discussed earlier in section 2.3, almost all households keep a few chickens, some keep turkeys and most keep pigs, though numbers vary within in the year. The better off families keep cattle, although the number of households keeping cattle has increased recently due to a programme of providing steers on credit.

Widespread and common diseases and illnesses affecting poultry, such as fowl-pox, colds, and diarrhoea are costly and problematic for campesino families who have limited means to cure illnesses that attack their poultry's weak immune system. Vaccination is not a viable option given the weak state of their poultry and their lack of access to veterinary assistance. Turkeys are particularly prone to fowl-pox and although large gains are to be had from breeding them, many campesinos are reluctant due to negative experiences based on death or theft of turkeys. An unidentified illness has devastating affects as it wipes out the majority of the poultry population.

Local Creole pigs are resilient to illnesses and the climate, and the local diet of maize and forage is adequate for their requirements. Due to the common belief that "American" pigs are better, many campesinos choose to rear improved breeds, despite the fact they have higher maintenance costs and are inappropriate to the local conditions. According to the State Government of Yucatan, cistercicosis and cholera have been eliminated and every effort is made to maintain the State free of these illnesses as Yucatan's commercial pig farms are now exporting to Japan. Nevertheless, Campeche does have these illnesses and as was seen during the research project, pigs with cistercicosis were slaughtered and the meat sold at a lower price than "healthy" pig-meat.

The main problems affecting steers are lack of forage and water during the dry season and the length of time required to fatten them, given the campesino's limited resources.

**Land tenure and access**

Campesinos' access to land (whether for grazing, cultivation or forest use) continues to be primarily through the ejido, as described earlier in sub-section 2.2. The size of ejido, number of ejidatarios, extent of individual plots or collective land varies according to the size of the individual villages, a factor determined by its history.

Access to agricultural land is influenced by gender, politics, economics and water sources. In the case of Xohuayan the size and location of the ejido's lands are limited due to the village being situated 10 km from the land it received. Further, the relatively small quantity of land belonging to the ejido and its poor quality has meant that younger heads of families are no longer given ejidatario usufruct rights and are obliged to rent land from neighbouring private landowners. The original founders of the village established their home in Xohuayan due to its deep water-well. Whereas the villages of X'culoc and Sahcabchen were haciendas and the villagers are the descendants of its peons, the lands are extensive. Mahas originates from when people moved away from a hacienda and created a village on national land (common property).

.

With the exception of one ejidatataria seen in X'culoc, ejidatarios are male members of the households (and generally the head of the household). Women do not therefore have direct rights for land access. Gender differentiation occurs within the realm of other natural resources. PRA exercises were carried out at group level within the four villages to enable an analysis of gender differentiation in ownership of natural resources. The results are shown in table 8 below.

**Table 8. Gender differentiation of ownership of natural capital**

| Man | Woman | Couple |
|---|---|---|
| Milpa, mechanised land | Poultry | Pigs |
| Crops- maize, beans, sweet potatoes | Solar – fruits and vegetables | |
| Honey | | |

## Physical capital

We consider physical capital under two main categories: general infrastructure within a community or village (and access to services) and private physical assets.

**Infrastructure**

Infrastructure includes roads and transport, educational and health facilities, access to water and electricity supplies, and communications. The level of infrastructure each village has is summarised in table 9 below.

**Table 9: Infrastructure in the four villages**

| | X'culoc | Sahcabchen | Mahas | Xohuayan |
|---|---|---|---|---|
| **Roads** | Difficult access<br>Stony track.<br>No through traffic: road stops in village | Paved roads<br>Constructed 1970s | Paved roads | Paved roads |
| **Transport** | | | | |
| Public transport | No public transport | Public transport: 2x/day a.m. to Hopelchen, p.m. return (Mex. $7 eachway) | Public transport: 1x/day to Tickakal (Mex. $7 each way). Traffic passing through. More difficult to return to village | Public transport: 1x/day to Tekal (Mex. $5) and Oxcutzcab (Mex $150) |
| Private transport | 4 private truck owners.<br>Truck owners give lifts for Mex. $20 - 50 return<br>50% h-holds own bicycles | 6 private truck owners | 2 private truck owners<br>Tricycles | 33 Private truck owners<br>32 h-holds with motorbikes |
| **Health** | | | | |
| Village Clinic | INDESALUD<br>Staffed by auxiliary | IMSS<br>Staffed by auxiliary | IMSS<br>Staffed by auxiliary | IMSS-constructing<br>Staffed by auxiliary |
| Visiting Doctor | Doctor visit every 4 weeks | Doctor visit every 3 weeks | Doctor visit every 4 weeks | Doctor visit every 4 weeks<br>Oxcutzcab |
| Nearest Hospital | Hopelchen | Hopelchen | Valladolid | |
| **Schools** | Kindergarten<br>Primary school<br>Telesecundaria<br>Secondary school under construction | Kindergarten<br>Primary school<br>Telesecundaria<br>Secondary school in Hopelchen | Kindergarten<br>Primary school<br>Secondary school in Tickakakapul | Kindergarten<br>Primary school<br>Telesecundario<br>Secondary school in Tickakakapul |
| **Electricity** | Installed 1996<br>Not known | 1970s<br>91% h-holds | 1970s<br>85% households | 1983<br>91% h-holds |
| **Water supplies** | Water pumps<br>1970s<br>52 % of h-holds | 1970s<br>97% h-holds<br>3.7 hours/day<br>(PPDP 1999) | 1977<br>100% | 1982<br>98% h-holds<br>8 hours/day<br>(PPDP 1999) |

| | | | | |
|---|---|---|---|---|
| **Shops** | 4 including a CONASUPO shop | 3 including a CONASUPO shop | 3 | 7 |
| **Communication** | One telephone in shop | No telephone | Telephone often not functioning | Telephone |

**Roads** vary from stony tracks to paved roads. Within the area, there are three types of roads: federal roads, which are constructed of asphalt; state feeder roads, which are paved; and rural roads, which are paved or stony tracks.

Road conditions within the villages range from paved roads to and within the village to an inaccessible 16km stony track (X'culoc village) which is particularly problematic within the rainy season, given the large amounts of mud which accumulates.

Transport systems within rural areas in the region are limited. Service delivery to the villages varies from one public bus per day to the nearest town to no public transport at all. Villagers are often reliant either on their own transport (bikes, motorbikes, trucks) but these are only owned by the 'well-off' (9 percent of households on average within the four villages), or on paying for lifts from private transport owners. Limited transport facilities deter villagers from visiting towns to visit a doctor, to market produce within the market town etc.

**Communication** systems are limited within rural areas of the region. Many villages have one telephone using a satellite system. Telephones are privately owned but for public use. User-costs are often high. Service delivery varies from village to village though many do not function or have poor transmission during the rainy season.

Within the majority of villages, there is a kindergarten, primary school and in addition a *telesecundaria*, a secondary schools which uses television to complement teaching. In the Yucatan there are 2972 schools; 31 percent are pre-school (kindergarten), 48 percent are primary, 14 percent are secondary and the remaining 7 percent are of higher education. In Campeche there are 1669 schools; 32 percent are pre-school (kindergarten), 52 percent are primary, 12 percent are secondary and 4 percent are higher education.

Household access to electricity and water supplies has improved in recent years. In Campeche and Yucatan States 91 percent of households have **electricity**. Three of the villages obtained electricity in the 1970s. X´culoc was the last to obtain electricity, in 1996.

In the region 82 percent of households have access to **water supplies** within their homes or solars. However, delivery service differs and in some villages, the service is poor. There are some charges within villages for the fuel for the pump (for example a payment of Mex. $9 every three weeks towards the diesel for the pump in X'culoc).

All villages have shops selling basic commodities such as beans, rice, tins of food, biscuits, sweets, some vegetables, refreshments, cleaning and hygiene products. Shop-owners are classified as the 'well-off' or 'very well-off' village members. One informant distinguished between those who are 'well-off' as those with small shops, and the 'very well-off' as owners of large shops

All villages have Catholic churches and some in addition have churches of other denominations, such as Presbyterian or Evangelical, religions which are growing in the region.

**Private physical assets**

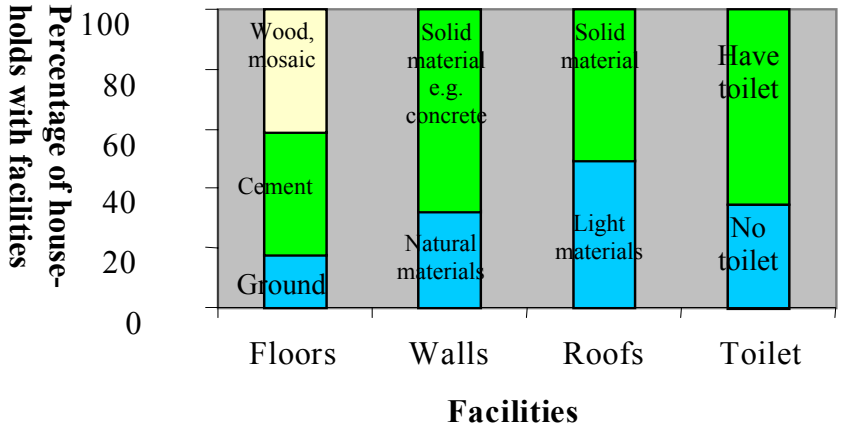
Here we consider access to two principal types of physical asset: private housing and production equipment.

Housing in the region varies. Housing conditions in the area as regards construction materials and toilet facilities are shown in figure 6 below.

These can be compared with housing in the four study villages; with 23 to 45 percent of households having concrete houses (see table 10) and ownership of toilets varying from none or very few in X'culoc and Mahas, to 71percent in Xohuayan.

Households own their own small-scale production equipment. Agricultural tools owned are axes, scythes, machetes etc. Tractors are generally hired from private owners. Those who keep bees own hives, protective clothing and other equipment. Women who sew and embroider generally have their own sewing machines obtained on credit from a government scheme. In terms of food production many households own hand mills though the majority of villages (all in the study areas) have privately-owned electric mills which are for public use.

**Figure 6. Housing Conditions in the Region**




*Source:* INEGI 1999

**Table 10. Housing in the study villages**

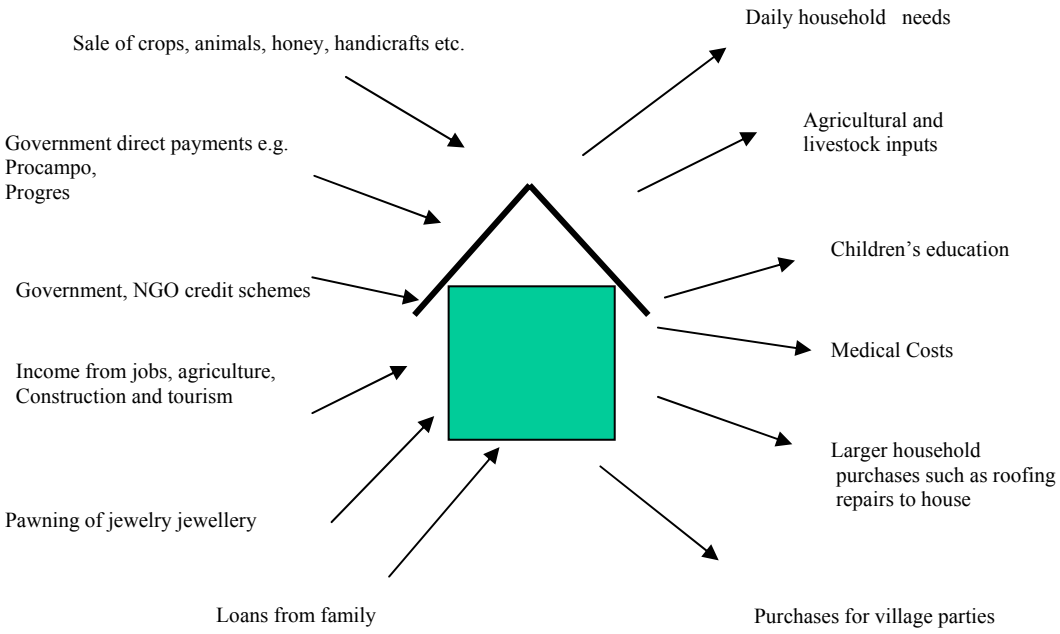
| | X'culoc | Sahcabchen | Mahas | Xohuayan |
|---|---|---|---|---|
| **Material** | 23% concrete | Not known | 33% concrete (approx.) | 45% concrete |
| **Toilet Facilities** | Few have toilets | 38% have toilets | None | 71% have toilets |

*Source:* Results of rural appraisal by project

## Financial capital

Here we consider households' access to money and to other liquid assets. It is important to recognise that money is not the only liquid or convertible asset in these livelihood systems. Maize, for example, is a vital part of the economy in X'culoc and acts as a medium of exchange within the shops in the village. Since assets may have multiple roles (maize grain, for example, acts as a food-source, savings, animal feed, and medium of exchange), we consider a range of income sources and mechanisms for saving and borrowing; liquid assets may be acquired through income, through borrowing, or through encashment (or withdrawal) of savings (see figure 7).

**Figure 7. Input-Output Diagram of Financoial Assets Portfolio**




The main income earning activities in the villages are crop production and wage labour with other contributions from sale of animals, honey and handicrafts. Other sources of liquid assets are savings (maize grain and pig keeping are often a means of saving), remittances from relatives, borrowing, and income from government programmes (outlined in sub-section 2.2). The balance between these income sources varies between households, an issue that will be discussed further in sub-section 2.4. Income earning activities were described earlier. Here we will therefore concentrate on other sources of liquid assets, primarily different means of borrowing and savings.

Credit is obtained in various forms. Within households, family members normally make loans at no interest rate. Loans are rarely sought from banks. Interest rates, travel costs and time, lack of collateral and readily available information amount to high transaction costs which deter potential borrowers. Since women do not have rights to land and limited wage employment opportunities, they find it more difficult to obtain loans.

In addition, some families whose children are away working or studying send remittances. One couple for example in Sahcabchen have six children working in Campeche (capital of the state) and

have sent sufficient money to help their parents to rebuild the house of concrete, tile the floors, buy an oven etc.

Pawning also takes place in the region. Gold necklaces are commonly owned and can be pawned for Mex. $100-150, with an interest of approximately Mex. $10 per month. However, the poorest members of the communities are unlikely to own jewellery.

As already mentioned, bank loans are generally inaccessible to campesinos and incur high transaction costs. However, credit is often offered within government schemes, and tied to other factors (such as credit for fertiliser purchases) so that factor markets are inter-dependent. Of the farming households in the states of Campeche and Yucatan 35 percent use credit and/or insurance, while approximately 17.5 use credit only (INEGI 1998). The INI scheme, for example, gave a loan of Mex. $80, 000 to a group of 11 men in Sahcabchen who are working on a tree-grafting scheme. The interest payments amount to Mex. $11,200 for each of the two years in which repayment is due. In X'culoc credit is available from a CONASUPO village shop for Mex. $200 at a rate of Mex. $10 per month. Some NGO projects in the villages provide credit for community initiatives. In Xohuayan, for example, a revolving fund was made available for collective pig-pens.

A few households, 'those that are well off', have savings in the bank. However, other aspects of the household economy can be considered as forms of saving. Animals, for example, act as a deposit account, as resources are dedicated to animal rearing, and then money can be 'withdrawn' or the animal sold when needed. In addition maize, when stored, acts as a form of saving.

An important source of income for some households is obtained from one or more of the many government grant programmes described in sub-section 2.2.

Many households within the region receive PROGRESA payments to assist in education costs. The amount received is Mex. $210 every two months (IMSS 1998). The number of households who receive PROGRESA grants varies from 54 percent of households in Sahcabchen to 95 percent in X'culoc. There is some controversy within the villages as to whether payments are really targeted at the poorest households.

PROCAMPO payments dedicated to the purchase of agricultural equipment, is another important source of cash. The amount paid is Mex. $708 per hectare and average holding size in the village

varies from two to four ha. Payment may be received in a number of ways. SAGAR, the agency that administers the scheme, provides untimely service and distributes payments after the sowing season. Campesinos therefore find ways, which can be expensive, to gain funds in advance. An advance can be received by a bank who request credit of Mex. $70 per hectare, and receive the payments directly from SAGAR. Alternatively, credit is available from an agribusiness company who manage PROCAMPO payments and provide access to chemical fertilisers, herbicides, pesticides etc. with a 2.5 percent rate on each product.

As expenditure and incomes vary during the year, so do families' stocks of liquid assets (money and maize) and they adjust their off farm employment, savings and borrowing activities accordingly. Table 11 below shows an income and expenditure calendar during the year for a household who engage in milpa, bee keeping, and embroidery livelihood activities and has children in school. It should be noted that dates of festivals vary between different villages.

**Table 11. Income and expenditure calendar constructed with three men in Mahas, January 1999**

| | Jan | Feb | March | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Incomes | Sales maize, Squash seeds | Sales maize, Squash seeds | Sales maize, Squash seeds | Honey | Honey | honey | | Maize* | Maize* | | | |
| Expenditures | H-hold basket | H-hold basket | H-hold basket | H-hold Basket | H-hold Basket | H-hold basket | H-hold basket<br><br>Buy agric. inputs Clothes for village festival | H-hold basket<br><br>School materials | H-hold basket<br><br>School materials | H-hold basket | H-hold basket | H-hold basket<br><br>Turkey, meat for Christmas |

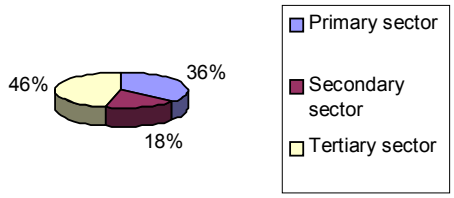
* Maize may be sold by those who have surplus, and bought in the same period by those with a shortfall. Those who participated in the calendar all had a surplus in 1998/99, explaining the absence of off-farm employment. Progresa and Procampo payments and animal sales are not shown.

## Human capital

We now turn to consider the human capital, the labour and skills campesino households use in their various livelihood activities.

Population statisitcs for the two states of Yucatan and Campeche were presented earlier in sub-section 2.2. In each state, the population in 1995 was very evenly divided between the sexes. Employment by the different sectors is shown for each state in figures 8 and 9 below.

**Figure 8. Labour profile in Campeche**



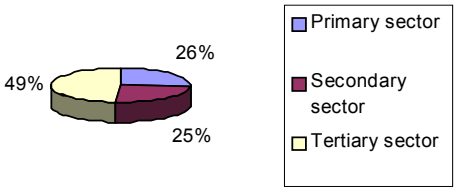
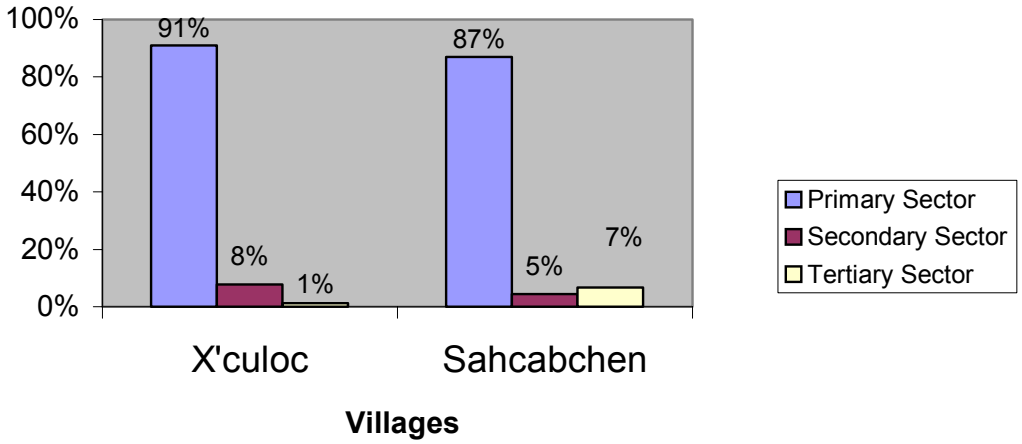




**Figure 9. Labour profiles in Yucatan**

*Source*: INEGI 1995

The data presented in figures 8 and 9 include both rural and urban populations. However, within rural areas the situation is quite different, with the majority of campesinos working within the primary sector. This is illustrated in figure 10 below, using X'culoc and Sahcabchen as examples.

**Figure 10: Labour profile of X'culoc and Sahcabchen**




The main unit of production is the household, which generally consists of the nuclear family despite the fact they may live within a stone's throw of their parent's and sibling's homes. At this level, consumption and production decisions are made and resources are pooled. Campesinos have a clear idea of the boundaries of the household as a nuclear family and had no difficulties in explaining the occasions and reasons for when resources are pooled and/or shared with relatives. Examples of sharing include; mother-in-law prepares a special meal, a deer has been hunted by one of the brothers and the meat is divided among extended family members. Population statistics for the states of Campeche and Yucatan estimate an average of 4.7 persons per household in 1995, with just over 40 percent of the population at less than 13 years old. While this figure is somewhat dated and has the disadvantage of pooling together rural and urban data it is borne through in the data collected for the Campeche villages but not the Yucatecan ones, as seen in table 12 below.

**Table 12. Demographic information for the study villages**

| | X'culoc | Sahcabchen | Mahas | Xohuayan |
|---|---|---|---|---|
| Population | 386 | 415 | 357 | 1,028 |
| No.of households | 77 | 94 | 58 | 147 |
| Household size | 4.8*, 6.3** | 4.4 | 6.1 | 7.1 |

* according to EDUCE (PPDP 1999);
** according to INEGI 1996.
*Sources:* IMSS, 1995; IMSS, 1999; INEGI, 1996; PPDP, 1999

Within the households, work tasks are generally shared according to gender and age as shown in the table 13 below, although there is some variation between households and times of year, with different households' structures and work pressures.

**Table 13. Gender and Age Division of Livelihood Tasks in the Region**

| Men | Women | Children |
|---|---|---|
| Milpa/mechanised – all activities | Cook | Help cleaning, cooking etc in house |
| Slash, burn trees, sow, weed, apply fertiliser, harvest maize and other crops | Clean house | Help in milpa |
| Solar – apply fertiliser | Wash clothes | Collect fuel-wood |
| Collect fuel wood and wood for construction* | Child-rearing | |
| Livestock-rearing | Solar – fruit and vegetable cultivation | |
| Honey production | Milpa – harvest beans and squash | |
| Sale of crops, pigs, livestock | Collect fuel-wood | |
| Employment within and outside of the village (agriculture, construction etc.) | Poultry-rearing | |
| | Pig-rearing (often shared with man) | |
| | Sewing, embroidery | |
| | Hammock-making | |
| | Sale of embroidery, poultry | |

* Fuel-wood collection may be a male or female activity. In one village (X'culoc) much is done by women.

Household labour availability is an influential factor on the pursuit of different livelihood activities. This is in turn affected by household structure (itself often determined by a household's position in the demographic cycle) and by the pressure of short-term income needs. Thus, for example, those households with more male adult labour may be able to invest more time in activities such as agriculture, bee keeping, rearing of steers and daily wage labour and extended income opportunities outside of the village. Those with more females in the family may dedicate more time to poultry and pig rearing activities, handicrafts, cleaning the house, agricultural activities etc. In addition, female labour may supplement male labour in the milpa. On the other hand, in poorer households men may be forced to take off farm employment to earn cash, and this puts more pressure on women to take on more agricultural tasks in the milpa, normally a male responsibility. 'Straddling' occurs, whereby different members live and work in different places, moving between town and village.

In those households in which there are infants, child caring will be a large part of the daily work of the female members of the household. However, as children grow up they require less child-care time and begin to contribute to household activities. Boys start to help their fathers in the milpa at approximately 10 years of age, and girls stay at home and help the mother with washing, child-care, cooking and cleaning chores. The amount of time available to help with these tasks also depends upon time needed for school activities, and this varies between households as they differ in the emphasis placed on education. In terms of elderly family members, there is a high dependency ratio within the region.

To illustrate this discussion of different household members' labour allocation to different tasks, Table 14 presents a daily profile for one household within the study area.

**Table 14. Daily time profile for a household in X'culoc (28/10/97 and 12/11/97)**

| Time | Mother | Father | Daughter | Daughter |
|---|---|---|---|---|
| **4am** | Wakes up, tends animals | Wakes up<br>Plans day | | |
| **6am** | | Breakfast | | |
| **7am** | Breakfast | Goes to fields (harvesting corn) | Breakfast | Breakfast |
| **7:30am** | Washes corn, buys breakfast, cooks | | Washes corn | Washes dishes, sews |
| **9:00am** | Goes to cut wood | | | |
| **10:00am** | | | Goes to work in village Health | Washes clothes* |
| **11:00am** | | Drinks pozole | Clinic | |
| **mid-day** | | | | |
| **1:00pm** | Repair fence | | Make tortillas | Make tortillas |
| **2:00pm** | Lunch | Lunch | | |
| **3:00pm** | Nap | Hunt animals | Lunch | Lunch |
| **4:00pm** | | | Wash dishes and | Rest |
| **5:00pm** | Remove corn from | Wash and rest | rest | Sew |
| **5:30pm** | cob | | Sew | |
| **6:00pm** | Wash | | | Remove corn from |
| **7:00pm** | Shop and make | Dinner | Remove corn from | cob |
| **8:00pm** | tortilla, dinner | Sleep | cob | Wash and temple |
| **9:30pm** | Sleep | | Paperwork | |
| **10:00pm** | | | | Dinner |
| **11:00pm** | | | Dinner and chat<br>Wash and sleep | Sleep |

* Clothes washing is an activity rotated between sisters

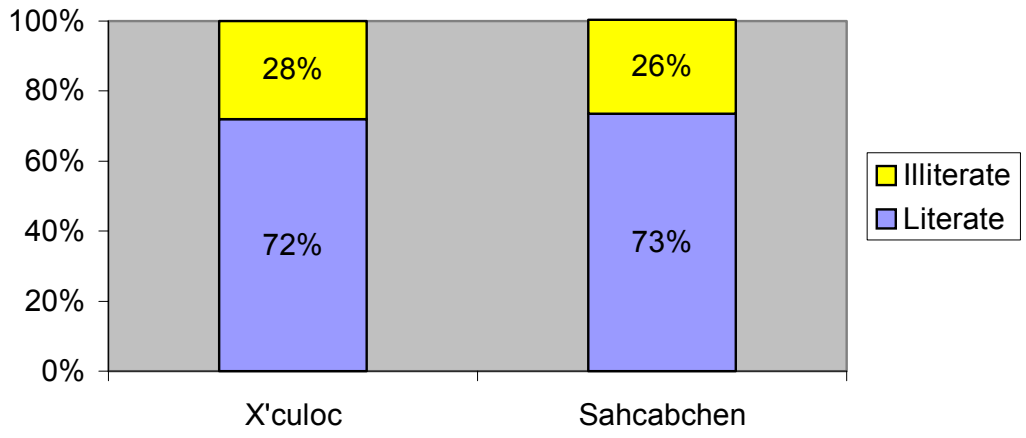
Skills of different household members generally match the gendered responsibilities within the households. Thus, girls develop skills for household chores, poultry and pig rearing and some agricultural activities, while boys develop agricultural skills and livestock rearing skills. Some individuals have received training and/or developed specific skills or trades, for example, in building or plastering, as a means to generate more income. Consequently, they are able to both find off-farm employment more easily and earn higher off-farm wages. External institutions are training villagers in different skills such as new agriculture and livestock-rearing techniques, apiculture, sewing, embroidery etc.

Education levels are low within the region. In Campeche, 92.65 percent of 6-12 year olds attend school. In 1994, many 15 year-olds were found to have incomplete education: 13 percent had no education, 25 percent had not completed primary school, 17 percent had completed it, 19 percent had basic education and 25 percent had an initial college education

(INEGI 1995). The high percentage with college education is somewhat surprising but there are no other data sources to contradict INEGI's findings. On average within schools, there is one teacher to every 21 pupils in kindergarten, 25.6 in primary school and 20 in secondary school.

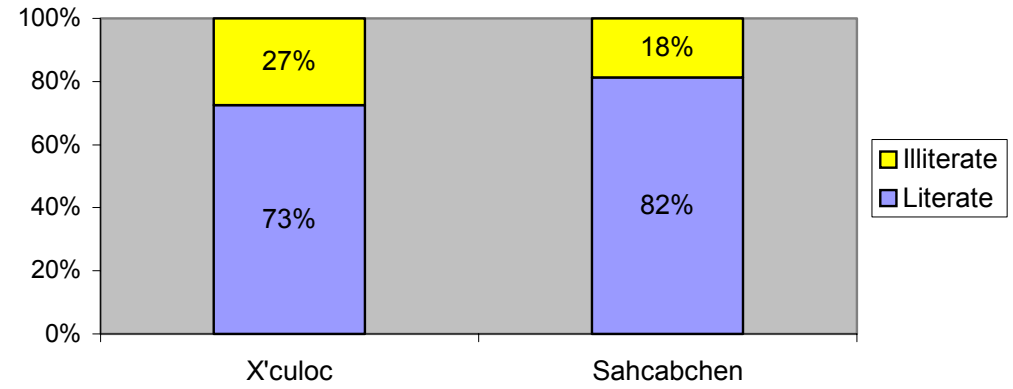
In Campeche the literacy level is reported at 85 percent (INEGI 1995). However, within smaller communities and particularly amongst women, illiteracy levels are higher, and literacy is rising amongst the young, although this varies between areas as shown in figures 11 and 12 below.

**Figure 11. Literacy levels amongst population over 15 years old in X'culoc and Sahcabchen**




*Source:* PPDP 1999

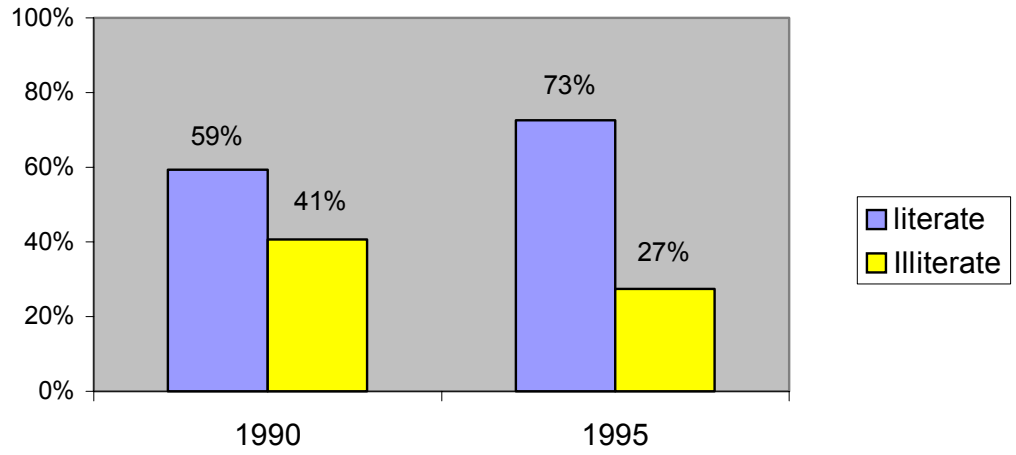
**Figure 12. Literacy levels amongst school age children in X'culoc and Sahcabchen**




*Source*: PPDP 1999

It should be noted that there has been a gradual increase in the rise in literacy levels in recent years. A notable increase in literacy took place in X'culoc between 1990 (59 percent) and 1995 (73 percent) (PPDP 1999), as illustrated in figure 13 below. This could be attributed to a literacy programme initiated by a local NGO, Educe.

**Figure 13. The increase in literacy within X'culoc**




*Source*: PPDP 1999

Little quantitative information is available about ill health and its effects on people's livelihoods except that debilitating illness and high medical costs (including transport costs) are cited as causes of poverty in the well-being rankings. As outlined earlier, the majority of villages have clinics and auxiliaries to treat every-day illnesses within the villages, but accessibility to doctors and hospitals is more limited. Common illnesses are respiratory illnesses, intestinal infections, diabetes and sclerosis (INEGI 1995).

## Social capital

Social capital refers to the social resources upon which people draw in their pursuit of livelihood objectives. The development of social networks, knowledge and sharing of that knowledge is vital to project innovation development and diffusion. Social capital is, however, difficult to measure and quantify. We will discuss it in terms of access to political influence, links with external agencies, and existence and membership of associations and networks within villages.

In terms of political hierarchy, within every municipality there is a local government body with a President and Committee. They are elected by vote for a three-year term. At the village level there are two main authorities: the municipal authority *El Comisario* which is a political representative and the ejido authority who represents the ejido at the municipal level. In the majority of villages, the municipal authority is elected. However, there are exceptions, for example, in Sahcabchen the President is designated by his predecessor. Politics have been noted to be a divisive factor within villages in Xohuayan. For example, the Ejido Authority has only given government assistance to villagers who share the ruling party's allegiance (Moya 1999).

There are a number of associations in all villages. Many associations are formed due to external initiatives. Table 15 shows the different groups that exist within the villages and, where information is available, the extent of participation. Government programmes encourage the formation and legal registration of groups in order to gain access to credit and to apply to participate in new government initiatives. In addition, the formation of groups has been encouraged within the changes to the land tenure system as collective areas have been established in which groups are eligible for credit schemes and other types of support.

**Table 15. Associations and participation in the villages**

| | X'culoc | Sahcabchen | Mahas | Xohuayan |
|---|---|---|---|---|
| | | **Government Programmes** | | |
| **Procampo** | ✓ 100% | ✓ 50% | ✓ | ✓ |
| **Rosa Tumba Pica** | ✓ 80% | ✓ | ✓ | ✓ |
| **Progresa** | ✓ 95% | ✓ 57% | ✓ | ✓ |
| **Alianza del Campo – Livestock** | ✓ | ✓ | ✓ | ✓ |
| **INI livestock** | ✓ | ✓ 12% | ✓ 95% | ✓ |
| **FONAES handicraft** | | ✓ 13% | ✓ 55% | ✓ |
| **INI handicraft** | ✓ | ✓ | | ✓ |
| **DIF Collective Kitchen** | | ✓ 42% | ✓ | ✓ |

| NGOs | | | | |
|---|---|---|---|---|
| **EDUCE** | Mill coperative - 25%<br>Horticulture | Mill cooperative - 7%<br>Nursery garden - 11% | | |
| **Kabitah** | Honey marketing | Honey marketing - 24% | | |
| **Hombre Sobre La Tierra** | – | | Agroforestry, Education | |
| **Misioneros** | | | | Minimum tillage<br>Collective pig-pen |

There are also village organisations set up without external interventions. Fajinas are traditional collective work groups (male and female) which conduct village cleaning, construction work, weeding etc. in public areas. In recent years, fajinas have become tied to PROGRESA payments, which act as a 'payment-in-kind' for such assistance. In addition, villages often have internal committees called *Gremios* for the organisation of village festivals.

The extent of participation, group nature and cohesion are important aspects of social capital though it is difficult to generalise amongst a variety of different groups. There does however appear to be a strong male bias in the main political decision-making groups and all-male or all-female groups appear to be the most prevalent associations. In addition it can be noted that many of the smaller groups comprise relatives and are extended family groups, thus there is a high kin-homogeneity within groups.

Religious practices and cultural traditions are prevalent in the whole region, and are often inter-household and sometimes inter-village events. Each village enjoys its special village festival. It generally involves traditional dancing (*jarana*), music, bullfights etc. The X'culoc festival includes the Dance of the Pig's Head, which consists of a cooked pig's head, decorated with sweets and coloured papers, carried on to the village streets, where there is music and dancing. A different tradition is that of the agricultural *cha'aak* ceremonies, which are carried out in order to ensure a good harvest. These are performed less and less nowadays because the younger generation does not believe in them, and there is insufficient money or resources to carry them out.

Intra- (extended) family collaboration varies in different villages of the region. In Sahcabchen, for example, younger households set up home-gardens and dwellings

independently of their parents, and there appears to be little pooling of resources except in times of extreme need. In X'culoc, in comparison, there appears to be greater mutual inter-dependence and solidarity among the extended family. This is observed as the sons maintain the tradition of living within the same home-garden area as their parents when they marry.

In Sahcabchen, the campesinos complained about the *egoismo* in the village – "people only think of themselves, and there is a lot of jealousy" (personal communication with villagers). In both 1997 and 1998, some of the campesinos with whom the researchers worked, had their mechanised plots burnt so that they lost their harvests. In addition, it was claimed that dead animals were thrown in other people's gardens in order to infect their neighbour's animals.

Alcoholism is a growing problem within the region. An indicator of this is that 2 percent of the population in the Yucatan, and 3 percent of the population in Campeche die of alcohol-related liver problems (INEGI 1996). Generally, only the men drink, as there are cultural taboos regarding female alcohol consumption. In Mahas, the female villagers obtained a ban on the sale of alcohol within the village due to the negative affect alcohol brought upon their men-folk. In Sahcabchen, men from 5 percent of households are said to drink extreme amounts of alcohol, and live on the streets. This is bringing obvious changes to the social fabric, with reports of violence within households and theft of poultry from home-gardens.

## 2.5 POLICIES, INSTITUTIONS AND PROCESSES

The major institutions and elements of government policy affecting campesino livelihoods have been discussed earlier in sub-sections 2.2 and 2.4, in relation to land tenure, political and household institutions and structures. We now turn to examine market structures, prices and subsidies.

### Markets

Peasant households are characterised by 'partial engagement in input and output markets which are often imperfect or incomplete' (Ellis 1992). Such circumstances are observed within the region due mainly to remote and fragmentary access to wider markets for finance, inputs and outputs. Consequently, campesinos engage in subsistence production and non-market exchanges of produce and labour service between households, with only limited participation in formal cash markets.

A critical factor affecting market integration is poor and incomplete market information, arising from poor physical infrastructure and communications (discussed earlier in sub-section 2.4). As part of the same vicious circle, lack of market involvement itself results in lack of market information. Where progress has been made in improving market involvement (for example, as in the case of honey producers in some villages) this has generally been promoted by outside NGO facilitation. Government agricultural extension institutions are reported to be highly fragmented with little effective co-ordination. They tend to be focused on commercial agriculture, on output maximisation with little regard to cost, on irrigated land (25 percent of agricultural area) rather than on rain-fed and on tropical agriculture. Therefore, most market and technical information is transmitted through word of mouth within the villages, and thus depends largely on social resources. No newspapers are sold within the villages and the telephones (which function erratically) are not used for such purposes. Thus, villagers are reliant on those who visit the village from outside (NGOs, government workers), or villagers who leave the village and return with relevant information. It should be noted that women have less access to such information given that they rarely participate in the sale of goods outside of the village. Accessibility to towns with reliable agricultural markets varies considerably between the four study villages, as shown in Table 16 below.

**Table 16. Accessibility to market towns**

| | **X'culoc** | **Sahcabchen** | **Mahas** | **Xohuayan** |
|---|---|---|---|---|
| **Distance from market town** | 48km | 25km | 58km | 12km |
| **Accessibility - transport** | Very Poor. No public transport Expensive, irregular private transport | Poor. Infrequent and expensive public transport, | Poor. Far from town, Infrequent and expensive public transport, return trips difficult, few private vehicles | Medium. Relatively close More public transport and more private transport owners |

Inputs are available on an erratic basis from government schemes (they may arrive late, or be distributed by the local Comisario according to political allegiances). Inputs from private sources are more reliable, yet require time and costs to purchase them. In addition, transportation can be difficult (especially for bulky inputs).

Marketing may occur within different spheres. Sales within the village may fetch a lower price yet involve no transport costs, and less risks and time. Products sold within the village include maize, beans, poultry and pigs. For goods such as maize, pigs and livestock, intermediaries from market towns come to the village to purchase. However, the price paid is considerably lower than in the market town. In addition, CONASUPO purchases and sells

maize at guaranteed prices either within the villages, or in shops in villages, within the municipality.

In other cases, campesinos go to market towns to sell their goods (maize, beans, vegetables, fruits and honey) to intermediary traders. Sometimes there are some well-known intermediaries, and thus campesinos are aware of potential purchasers. Intermediaries give reputedly low prices for many products. In some areas, family members sell their produce on a small kiosk in a market. For example, villagers from Xohuayan may sell produce in this way in the largest fruit and vegetable market of the Peninsular in Oxcutzcab.

## 2.6 VULNERABILITY AND CHANGE

We can identify four important types of change affecting campesino livelihoods: trends, shocks, normal variation between years, and seasonal change or cycles within years. We examine the extent and effects first of shocks and trends and then of seasonal cycles. 'Normal' variation between years occurs in rainfall, yields, prices, opportunities for employment, and animal production (such as litter size), for example, often within a seasonal context. Such variation is a normal part of life, but it poses significant challenges to campesino livelihood strategies as it is pervasive and has complex interaction effects on all aspects of household livelihood. Rainfall, for example, is particularly variable between years, and affects the timing and extent of yields, farm labour demands, off farm employment, etc.

### Shocks and trends

Hurricanes are the major naturally occuring shocks that affect the area. Table 17 below shows the different hurricanes and natural shocks experienced by one village in the area and the damage suffered.

**Table 17. Natural shocks affecting Sahcabchen,**

| Year | Event | Damage |
|---|---|---|
| 1955 | Hurricane Janet | Demolished village roads |
| 1959 | Hurricane Hilda | Floods ruined the village. However high production due to high rainfall level |
| 1970 | Human epidemic | Whooping cough and measles |
| 1974 | Pest invasion | White mosquito attacked melon, watermelon, tomato, chilli |
| 1988 | Hurricane Gilbert | Valley and road flooded for six months. Change in climate. More damage than Hurricane Janet. |

*Source:* Timeline conducted with villager in February 1997

In addition, a severe drought, which hit the area in 1996, was reported to be the worst in forty-three years.

Economically, the devaluation in 1994 was pervasive in terms of high inflation. It affected campesinos in the area two-fold. Consumer prices increased and the value of assets declined. Market opportunities became more remote. Devaluation is associated with presidential elections, held at six-year intervals and often causing both political and economic stability. However, no such devaluation has occurred as a result of the latest change in the nation's presidency in December 2000.

Sub-section 2.2 described major changes (both trends and shocks) in policies, in land access and in the general economic situation. Overall, these appear to have affected campesinos negatively; they certainly have not shared in the general growth of the economy. As discussed briefly at the start of sub-section 2.2, campesinos have mixed views as regards overall changes in welfare during the last 50 years.

The combined effect of many of these changes is a squeeze of lower agricultural productivity and higher cash income requirements. Lower agricultural productivity results from increasing land pressure and shortened fallow cycles discussed earlier. Higher cash income requirements then arise from food shortfalls during the critical period prior to harvest (July to September) and the need to purchase agricultural inputs. In addition, services such as electricity, water, education and health, which have become available in the last thirty years, require cash expenditure. In addition, as discussed in sub-section 2.3, the cost of living within the region has increased in recent years.

Campesinos are responding to these challenges in a number of different ways. All have had to adjust their agricultural activities as the shorter fallow periods led to declining soil fertility and greater weed infestation. There has been an increase in the use of external inputs such as chemical fertilisers and herbicides in recent years. Input policies and packages are available from the government, which provide fertilisers, seeds etc. at subsidised prices to farmers. Such changes in management have marked transitions in the traditional milpa system. NGOs and DISE are working towards agricultural systems, which are low external-input systems.

## Seasonality

Seasonal changes within the year are severe and pervasive within the area, affecting almost every part of campesino life. The changes in climate across the year not only determines when farming activities take place, but they also influence human health, animal health, employment opportunities, and the critical period when there is often a food shortage.

Festivals also may make important seasonal demands on families. Christmas and Easter are important festivals across the area. In addition, each village has its own particular festival. During festival periods, families may not undertake normal work for up to a week or so, and are socially required to buy new clothes and to incur other extra expenditure such as the slaughtering or purchasing of turkey. Prices may also change across the year, with grain and animal prices and local wage rates changing with supply and demand. Income and expenditure requirements within the year were shown in Table 11. Periods of peak demand for labour and inputs in crop production are not explicitly shown in the table. These occur from September - November for the slashing of the milpa, March-April for the slashing of the mechanised lands, June to July for the purchase of inputs and the preparation of land and October-November for the harvesting period.

## Vulnerability

Understanding of these seasonal changes is critical for understanding the vulnerability of poorer households, who are most affected by the critical hunger period. If maize and cash resources run out there is generally the need to look for work on other farms in the village or elsewhere. This leads to a lack of input to their own fields, and reduced harvest (dependent on other labour resources in households). As poorer households struggle to maintain their immediate consumption and medium term productive activities through the year, they are particularly vulnerable to specific shocks. Examples of shocks would be: sickness in the family, which reduces labour available for wage labour or farm activities and demands cash for medical and transport costs, or the death or theft of an animal, which depletes their savings bank. Animal keeping strategies are driven by the seasonal supply of maize (and associated seasonal income) and by problems of using seasonal income to sustain consumption through the year. Paradoxically, animal keeping may be more important among poorer households as a means of trying to maintain assets to support consumption throughout the year. Animal sales occur at critical times thus supporting consumption of basic foods, but animal rearing is

also limited among such households because of competition between people and animals for maize.

Poorer households with restricted resources for buffering during the critical period are also those most vulnerable to more general adverse shocks and trends such as sudden commodity price rises, loss of government services, or inflation.

Gender and age composition of households is an important contributing factor to vulnerability. As noted earlier, women have no direct rights of access to land, and female headed households are therefore denied rights to an important livelihood activity. Elderly households are prone to sickness and often lack labour to cultivate their land. Such households then become dependent upon support or remittances from relatives (normally children) and on charity. Young households with small children may also be particularly vulnerable, as they tend to be short of labour due to the demands of child care, also young children may be prone to sickness.

## 2.7 LIVELIHOOD OUTCOMES AND PROBLEMS

We conclude our general consideration of the livelihood systems in the area by considering first the livelihood outcomes of campesinos in the area, and then the problems that constrain them.

### Livelihood outcomes

We examine the livelihood outcomes of campesinos in the area from two different perspectives: firstly, from their perceptions of wellbeing, and secondly by examining indicators of quality of life and access to services.

**Campesino perceptions of 'wellbeing'**

As discussed in sub-section 2.2, statistics on the number of poor people in rural Yucatan are not available. However, in the villages where the project worked, campesinos' themselves described 50 to 90 percent of households as poor or very poor. Discussion of different categories of campesino households and their associated livelihood characteristics will be discussed later in sub-section 2.8 but it is important to consider here the large proportion of people considered as poor. Wellbeing rankings were conducted in each of the four villages, a generalised depiction of the results are shown in table 18. The categorisations used in each

village were not exactly comparable, and these results should therefore be interpreted with care. However, the extent of poverty is clear.

**Table 18. Proportion of households by wellbeing category in each village**

| | X'culoc | Sahcabchen | Mahas | Xohuayan |
|---|---|---|---|---|
| **Poorest** | 18% | 13% | 11% | 20% |
| **Poor** | 59% | 41% | 80% | 37% |
| **Not so poor** | | 33% | | 21% |
| **Better off** | 16% | 13% | 8% | 9% |
| **Well off** | 7% | | 1% | 16% |

**Campesino perceptions of wellbeing over time**

PPDP, a network of different NGOs and campesinos, carried out a participatory appraisal of the region during the period 1998 - 2000. As part of the appraisal they conducted a survey to determine villagers' perceptions as to whether they live better now or in the past (the time of the grandparents).

Within the Chenes area (within which are X'culoc and Sahcabchen), 14 percent considered that they live equally to how they did in the past; 34 percent considered that they live better; 43 percent considered that they live worse now and 9 percent of households did not respond. The same survey was carried out in Xohuayan, where a higher percentage of those interviewed (50 percent) stated that life is better now than in the past, corresponding to the present improved production conditions; 37 percent stated that they lived better in the past, and 12 percent considered that there had been little change.

Reasons for life being better now were:

- *life is more comfortable*
- *we work so that our children can progress*

- *Electricity, water, health, road, transport services exist and shops*
- *economic conditions before were harder*

Reasons for life being better in the past were:

- *now everything is more expensive*

- *before they had less expenses*
- *they obtained everything from the harvest*
- *they had more income*
- *they had more food security*
- *they could do everything without the help of the president*
- *the harvest was better*
- *there were no pests*
- *they did not use chemicals*
- *there was more forest*
- *there were more animals to consume*
- *there were more eggs, beans*
- *there was a little of everything without having to pay for it*
- *today you have to pay for electricity and water*

Reasons for living 'the same' now as the past were:

- *poverty has always existed*
- *there is not much work now*
- *everything is expensive*
- *only some things have changed*
- *you can have everything now but you have to pay.*
- *although it is expensive you can find work outside of the village*

As noted earlier, these perceptions reflect campesinos' continuing reliance on agriculture as well as the pressures that exist within agriculture. At the same time as there is increasing involvement in the market economy. These perceptions are also born out by examination of various poverty indicators, to which we now turn.

**Poverty indicators**

There are various indicators of poverty levels. Discussions of some of these, such as housing conditions and access to services have been included within earlier discussions of households' access to capital. Thus, as mentioned most (but not all) households have access to basic medical services but are more remote from secondary facilities, and most have access to primary education, electricity and piped water. About 70 percent of campesinos are literate, but there is evidence that this has been improving in recent years.

The number of children under five years of age with malnutrition can be a useful indicator of wellbeing, and the incidence of malnutrition is shown below. The high prevalence of light malnutrition must be a matter of concern and an indicator of poor well being.

**Table 19. Incidence of malnutrition in the three of the villages**

| | X'culoc | Sahcabchen | Xohuayan |
|---|---|---|---|
| **Total % of children with malnutrition** | 68% | 55% | 59% |
| **Light** | 50% | 55% | 34% |
| **Moderate** | 18% | | 19% |
| **Serious** | | | 6% |

*Source:* IMSS-Solidaridad 1999, EDUCE 1998 and 1999 cited in PPDP 1999

No direct information is available on incomes of campesino households, but it is possible to draw up budgets of approximate income estimates.

**Principal problems affecting livelihoods**

To conclude our review of the general features of campesino livelihoods, we consider the major problems affecting different livelihood activities. Many of these will have become apparent in discussion of the different livelihood components.

A useful summary of these problems emerged from the findings of a survey conducted in 1993, by the International Centre for Research in Agroforestry (ICRAF), the National Institute for Research in Forestry, Agriculture and Livestock (INIFAP) and the Veterinary Faculty of the University of Yucatan (FMVZ-UADY), as shown below:

General observations:

- lack of information, insecurity and differences of opinion with regards to the constitutional changes in land ownership and the new forestry legislation
- water shortage

- agricultural production faces product price instability, scarce markets, power of intermediaries in marketing mechanisms
- widespread indebtedness and restricted access to new credit due to previous poor credit
- poor communication, organisation and strong political intervention in ejido management
- low incomes caused by local productivity, hence low investment in agricultural production

Milpa (traditional slash and burn agriculture)

- decreasing soil fertility – rapid decline in yields after first year
- lack of suitable land (short fallow period and high demand for land)
- deficient rainfall (changes towards shorter and more erratic rainy season)
- high incidence of weed invasion
- poor adoption of technology e.g. High Yielding Varieties, fertilisation, herbicides
- pest problems in horticultural crops and in crop storage

Solar (home-gardens):

- poor draining soils
- loss of plant diversity
- lack of water for trees and vegetables
- lack of diversity in livestock
- fowl pox problem in turkeys
- extensive livestock management and poor nutrition

*Source:* ICRAF, 1993.

Table 20 draws on a more recent review of rural livelihoods to relate these problems to a finer breakdown of activities, and to their products and functions in the livelihood.

**Table 20. Problems associated with campesino activities, their products and functions in the livelihood**

| Activity | Current Problems |
|---|---|
| Milpa, mechanised cultivation, slash, burn trees, sow, weed, apply fertiliser, harvest maize and other crops | Increasingly low yields<br>Insufficient land<br>Increase in weeds, weeding time<br>Increase in number of pests<br>Incorrect application of chemicals<br>Loss of traditions as regards practices and culture |
| Solar – horticulture, sowing, weeding, harvesting | Insufficient water<br>Inadequate animal coup installations<br>Insufficient technical advice |
| Animal-rearing | Insufficient feed (or resources to obtain it) to be able to increase quantity of animals<br>Lack of knowledge of health issues<br>Insufficient technical advice |
| Bee-keeping | Yields lower due to heavy rains and erratic flowering<br>Increase in pests<br>Lack of capital to provide complementary food<br>Dependence on international markets and regional intermediaries |
| Wood collection | Reduced number and diversity due to deforestation |
| Hunting | Reduced number and diversity due to deforestation |
| Household activities (cleaning, cooking, childcare etc.) | Given increased need to generate income, many women work in addition on handicrafts.<br>Time pressures. |
| Sewing, embroidery, hammock-making | Work undervalued (price of finished garment is cost of materials)<br>Lack of resources to buy inputs<br>Lack of organisation to improve marketing |
| Wage Labour | Necessity to move away from village<br>Unable to cultivate milpa,<br>Changing social fabric |

*Source:* Problems cited in PPDP, 1999.

The importance of these problems to different households depends upon the importance of the different activities within their overall livelihood strategy. We therefore consider next the different patterns of livelihood activity pursued by different categories of household.

## 2.8 LIVELIHOOD CHARACTERISATION

Wellbeing rankings were carried out in the four villages. The aim was to determine the local perceptions of wellbeing within the area, and to develop an improved understanding of the importance of livestock and crop production, according to the different wellbeing stratum. The methodology, limitations and difficulties of wellbeing stratification are discussed in

Section Three. In general terms, wellbeing ranking provides a rich insight into perceptions of wellbeing and the differences that exist within a village. Importantly, it also allows research and development projects to be appropriately targeted at the very poorest. However, the heterogeneous perceptions of wellbeing pose difficulties in terms of developing uniform definitions and sizes for different wellbeing strata, reflecting the complex reality. Terms applied in one village such as 'poor' or 'well off' convey a different set of relative wellbeing characteristics in one village to another. It is difficult given these variations to compare villages according to their relative level of wellbeing. However, within analysis of characteristics (rather than titles) of different wellbeing strata, common themes emerged regarding patterns of livelihood activity pursued, household asset base and socio-demographic structure. These themes will be discussed below.

Households considered "poorest" vary from comprising 11-19 percent of the population within the different villages (X'culoc - 18 percent; Sahcabchen - 13 percent; Mahas - 11 percent and Xohuayan - 19 percent). The poorest households in all villages tend to be characterised by their socio-demographic household structure: an elderly couple (in all villages), a household with many children (in three villages) or a 'new household' or newly-weds in two villages. In addition, in at least three villages the poorest households are said to work as day labourers in order to generate income to meet immediate maize and other consumption demands rather than investing in the milpa. In terms of animal ownership, the poorest households in all villages have poultry, and in at least two of the villages, they own pigs. The poorest households are in general characterised as having palm roofed houses rather than the concrete houses, which better off households inhabit. In the case of one village, Sahcabchen, the poorest category comprises the alcoholics of the village, who generally live on the streets and do not support their households. Remittances from children were considered to be important to the poorest households within another village, X'culoc. Medical costs are considered a debilitating factor for the poorest households, as they are more vulnerable to shocks.

Households which were classified as "poor" within the villages vary from 36 - 80 percent (X'culoc 59 percent; Sahcabchen 41 percent; Mahas 80 percent and Xohuayan 36 percent), this category is considered to be largest in all villages. Most definitions of the poor Stratum rest upon asset portfolios and livelihood activities rather than socio-demographic structure. Households cultivate milpa but produce insufficient amounts of maize for the duration of the year and thus hire out their labour during critical times of the year (June/July to September). A few households carry out small-scale honey production in two villages and own steers on credit within associations in one village. Households have pigs and poultry in all villages and

generally have more than those households within the poorest category. Most houses have palm roofs. In the case of Sahcabchen the poor households were characterised as consisting of alcoholics, elderly or just married as in the poorest category. In another village, Mahas, medical costs were highlighted as a debilitating factor amongst this stratum. In three of the villages, it was considered that the poor households generally have many children.

Moving up the poverty scale the campesinos carrying out the rankings identified the "not so poor" households, who constitute 8-33 percent in the four villages (X'culoc - 16 percent; Sahcabchen - 33 percent; Mahas - 8 percent and Xohuayan - 8 percent). The principal distinguishing factor between the not so poor and the poor households is their self-sufficiency in maize, which is pivotal to food and feed availability and the need to generate income to purchase maize. In addition, the diversity of assets and activities is highlighted within all villages. Although the milpa is the main livelihood activity, not so poor households generally have more varied production than the poor households, with households carrying out honey production in all villages and the ownership of steers on credit within three villages. Some households in two of the villages own small shops thus providing cash opportunities, and in the other two villages, labour is hired out within difficult periods. Within one village, Sahcabchen, remittances from children are a significant source of income. Houses are generally made of concrete and few have palm roofs. In addition, households may own trucks or minibuses within two villages, and own motorcycles in a third. Resistance to shocks within the not so poor households is considered higher as medical costs are not such a debilitating factor.

The slightly better off and well-off households within the villages range from 1-15 percent (X'culoc - 7 percent; Sahcabchen - 13 percent; Mahas - 1 percent and Xohuayan - 15 percent), and share many of the characteristics of the not so poor but have more assets. Households are self-sufficient in maize, and in the case of three villages hire-in labourers to cultivate the milpa. Households in all villages own and manage shops and in many cases own trucks or minibuses. Households have numerous hives and own steers privately or on credit. Houses are made of concrete within all of the villages. A significant differentiating factor between the well off and the other Stratum is income. Wages and/or savings are a feature of the households that are considered well off and thus are more resilient to shocks and changes. Despite this resilience in two villages, it was commented that households who had been well off had lost their wealth due to illness and were now poor.

The table 21 reveals the different wellbeing strata, and different characteristics used to characterise them by the informants in the four villages:

**Table 21. Well-being characteristics across four villages – social & human capital**

| **Well-being criteria =>** | *Elderly* | *Many children* | *Widows or Single mothers* | *Just Married* | *Medical costs* | *Off-farm Labour* | *Remitt-ances from children* | *Salary or money in bank* |
|---|---|---|---|---|---|---|---|---|
| **Poorest** | | | | | | H O* | | |
| | | | | | | all year | | |
| **Poor** | | | | | | H Diffi- O* cult | | |
| | | | | | | times | | |
| **Not so poor** | | | | | | H Diffi- O* cult | | |
| | | | | | | times | | |
| **Slightly better-off & Well-off** | | | | | | H I** | | |
| | | | | | | | | |

* HO - Hired out, ** HI - Hired in

Xohuahan
Mahas
Xculoc
Sahcabchen

*Source:* Wellbeing ranking PRA exercise carried out August 1998 - June 1999

**Table 22. Well-being characteristics across four villages – natural resources capital**

| **Well-being criteria =>**<br><br>**Well-being category:** | *Self-sufficient in maize* | | *Poultry* | | *Pigs* | | *Steers* | | *Honey- Bees* | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Poorest** | | | | | | | | | | |
| | | | | | | | | | | |
| **Poor** | | | | | | | | | | |
| | | | | | | | | | | |
| **Not so poor** | | | | | | | | | | |
| | | | | | | | | | | |
| **Slightly better-off & Well-off** | | | | | | | | | | |
| | | | | | | | | | | |

Xohuahan
Mahas
Xculoc
Sahcabchen

*Source:* Wellbeing ranking PRA exercise carried out August 1998 - June 1999

**Table 23. Well-being characteristics across four villages – physical capital**

| **Well-being criteria =>**<br><br>**Well-being category:** | Palm roof house | | *Concrete/ stone house* | | *Shop* | | *Motorcycle* | | *Truck or combi* | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Poorest** | | | | | | | | | | |
| | | | | | | | | | | |
| **Poor** | | | | | | | | | | |
| | | | | | | | | | | |
| **Not so poor** | | | | | | | | | | |
| | | | | | | | | | | |
| **Slightly better-off & Well-off** | | | | | | | | | | |
| | | | | | | | | | | |

Xohuahan
Mahas
Xculoc
Sahcabchen

*Source:* Wellbeing ranking PRA exercise carried out August 1998 - June 1999

As already mentioned, such wellbeing characteristics are not static, from one year to the next, or within the same year, there may be fluctuations in both the characteristics and proportion of villagers within different strata. A poor harvest or a severe illness within the household may cause a household to suffer a fall in its wellbeing level, which may not be recuperated until a number of years afterwards. A change in wellbeing may not indicate a permanent change. This was the case for one household, who following an exceptionally good chilli harvest constructed a concrete house, though poor maize harvests in following years meant that the household resumed their previous wellbeing level. In addition, the 'life cycle' of a household has important implications for changes in wellbeing. For example households who have many young children often improve their level of wellbeing when children grow older and contribute to labour needs.

It is interesting to highlight the contribution of animals within the different wellbeing strata. Poultry, though kept by households in all strata, perform different roles within the household economies of different strata. Poorer households tend to have less turkeys and simirlar numbers of chickens as compared to the better off. Amongst the poorest and poor, they are largely used for sale, in particular during critical periods (maize scarcity, illness etc.). On the contrary the not so poor and well off generally use them for consumption throughout the year. In the case of pigs, poorer households keep a single growing animal (sold at times of need) that may be kept for reproduction. Whereas better off households have between maintain a slightly higher number of growing pigs. They are an important source of income in times of illness, maize shortage, village parties etc. as discussed further in section on animal inventories. Pigs are generally used for sale within all strata (though households keep some meat and fat for household consumption). Notably, the poorest and poor sell piglets at critical periods; selling them before they have fattened due to low maize feed resources and cash demands.

It is useful to elucidate the central role which maize plays within wellbeing categorisation, as exemplified by one campesino "the village is not the same - there are some people who have more maize then others" (villager, X'culoc). The poorest households, as discussed, have a lack of available labour to carry out agricultural tasks to produce sufficient maize. Earnings are spent on maize for immediate consumption needs and no maize production is carried out. The poor cultivate the milpa, but maize production is insufficient to sustain them throughout the year. Thus, household labour is hired out during critical periods in order to purchase maize and other necessities. On the contary, the well-off are self-sufficient in maize and have surplus which they store and sell at a higher price. Finally, those with trucks are able to

purchase maize from other villagers and take it to buyers who offer the best price. The poor are limited to fewer buyers who often offer lower selling prices.

Livelihood characterisation using wellbeing strata reveals variations in livelihood patterns across different wellbeing strata and different villages. This is useful in understanding campesinos access to resources and the way that they adopt and adapt them for different innovations. The differences in conditions and circumstances that exist between villages are discussed within the next sub-section.

## 2.9 VILLAGE CHARACTERISATION

The environment in which they operate mediates campesino households' resources, opportunities and constraints. The history, traditions, market opportunities, resource base etc. interplay in households' livelihood activities decision-making. Detailed analysis of each village, using the sustainable livelihoods framework can be referred to in appendix…. In Table 24, the differentiating features that influence livelihood activities in each of the four villages are set out.

In the following chapter, we present the methodology used in this research project, including a description of the project's overall plan and of the socioeconomic tools applied.

**Table 24. Villages' Characteristics affecting livelihood activities**

| Characteristics | Sahcabchen | Xohuayan | Mahas | X´culoc |
|---|---|---|---|---|
| **Historical features** | No hacienda roots | Founded by ex-hacienda peasants | Ex hacienda | Ex hacienda |
| **Ethnicity** | Mestizo | Less mestizo | Less mestizo | Less mestizo |
| **Population** | 431 | 1,028 | 350*** | 386 |
| **Access** | Poor* access | Good access close to large market town | Poor access | Very poor access<br>Stony track, 48 km to market town , no public transport |
| **Village Infrastructure** | Medium** | Medium | Poor-medium<br>No secondary school | Poor<br>Electricity only in last 4 years<br>No paved streets within village |
| **Constraints to agricultural production** | Poor permeability of soils – susceptible to floods | Land access problems – 10-35km distance to ejido lands<br>Hardly any flat lands | Stony soils – constraint to mechanising | None |
| **Agricultural activities** | Milpa<br>Mechanised<br>Rent land to agribusiness companies<br>Tree nursery | Milpa –high diversity of cropping<br>Minimum tillage common (NGO) | Milpa<br>Agroforestry area (irrigated) (NGO) | Milpa<br>Mechanised |
| **Animal rearing characteristics** | Bee-keeping co-operative (NGO) | Improved pig rearing (collective and individual pigpens common) (NGO)<br>Cattle rearing tradition | | No pig rearing tradition<br>Bee-keeping co-operative (NGO) |
| **Distinguishing livelihood activities** | | Migration to USA | Seasonal migration to tourist areas | |
| **Village social characteristics** | Alcoholism | PRI/PAN political divide | V. few children | Progresa grant (education grant awarded to poorest households) – 95% of h-holds |

* Poor access refers to poor roads and limited public transport.
** Medium level of village infrastructure - exists in village primary, secondary school, clinic, electricity, potable water, paved roads; poor or poor-medium = lacking in one or more or facilities listed.
*** Estimated figure.
*Source:* PPDP 1999, CENECAM 1999, IMSS (no date).

# 3 PROJECT METHODOLOGY

## 3.1 AN OVERVIEW OF THE RESEARCH PROCESSES

The work was founded upon the agroecosystem principles. The project sought to contribute to the improvement of the livelihoods and food security of families from marginalised rural campesino communities in SE Mexico. Our contribution was in terms of **products** - agroecological technologies, and of **processes** - enhancing peoples' capacity to generate agricultural innovations.

The main hypothesis of the project was that ways could be found to utilise the biomass produced in innovatory small-scale crop systems, by the integration of livestock, so that both the production of food and the utilisation of feed and forage[5] can be optimised. The impact of this optimisation will be measured in terms of improvements in family livelihoods and food security, and the consolidation and uptake of agroecological innovations in campesino agriculture.

Following the inception phase, during which contacts were established with local NGOs and through them with campesino communities, the project was operated contemporaneously along three overlapping activity axes as shown in Figure 14 below. These are:

a) action-research:

- initiating participatory appraisals,
- facilitating processes of *campesino* experimentation (CE),

b) on-station research:

- generating relevant scientific information,
- trials to identify the feeding values of crops,
- experimenting with crop / livestock interactions,

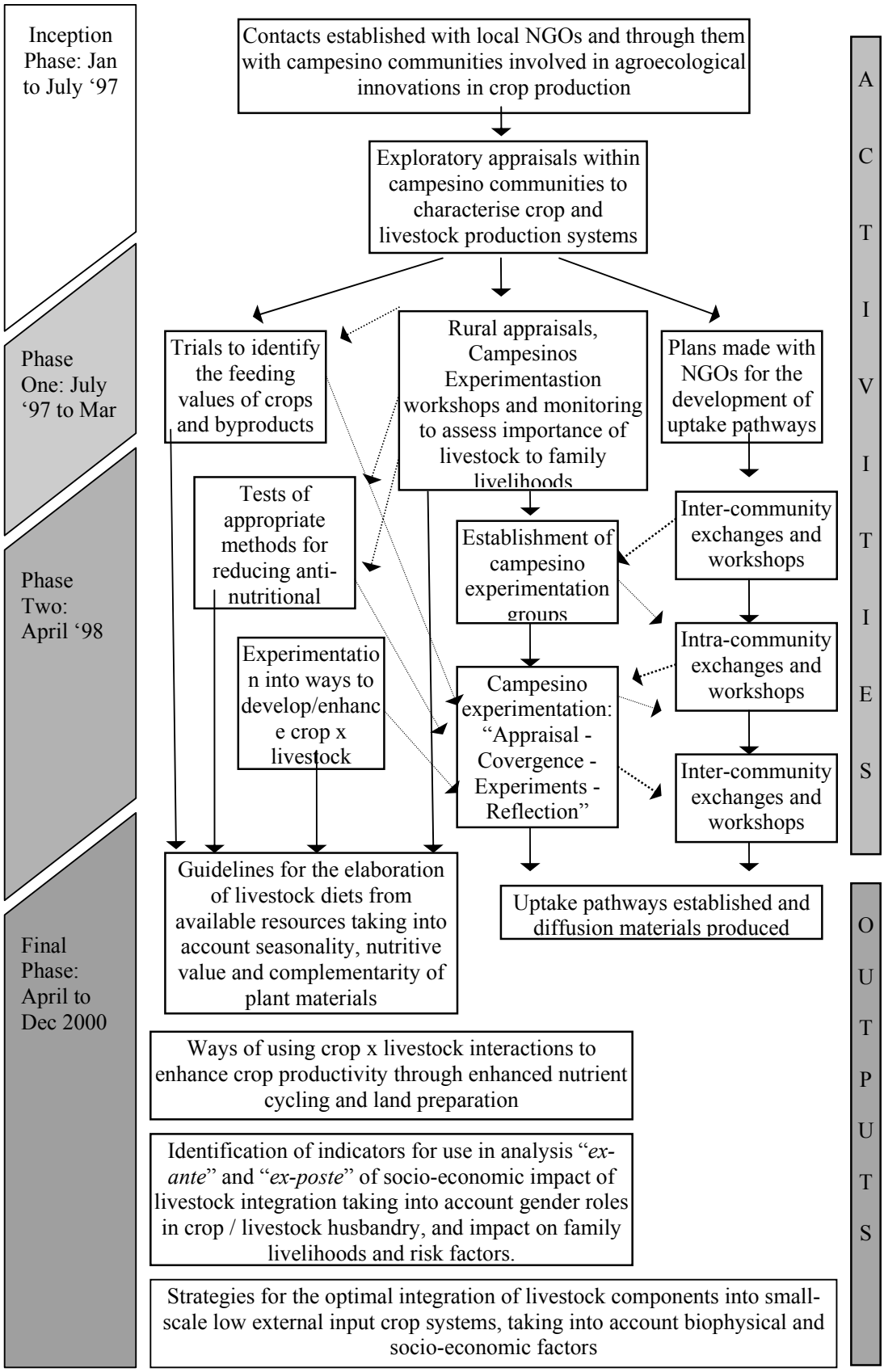
c) building uptake pathways:

- promoting *campesino* to *campesino* interchanges,
- promoting the use of participatory methods of appraisal and technology development by local NGOs and *campesino* organisations,
- providing technical assistance to community development projects.

The arrows depicting information flows in Figure 14 show how these axes feed into one another.

[5] Food here is used to refer to products consumed by families, feed and forage is that fed to livestock.

**Figure 14. An outline of the project's methodology**



## 3.2 ACTION RESEARCH

The action-research activities follow an iterative sequence designed to establish and consolidate dynamic campesino / researcher linkages. The sequence consists of:

**Appraisal:**

- dynamic characterisation of livelihood maintenance strategies and agricultural production.

**Convergence**

- identify families interested in the theme of crop/livestock integration and willing to provide case study material
- identify themes for the CE
- establish CE groups
- initiate case studies and socio-economic research methods.

**Experimentation**

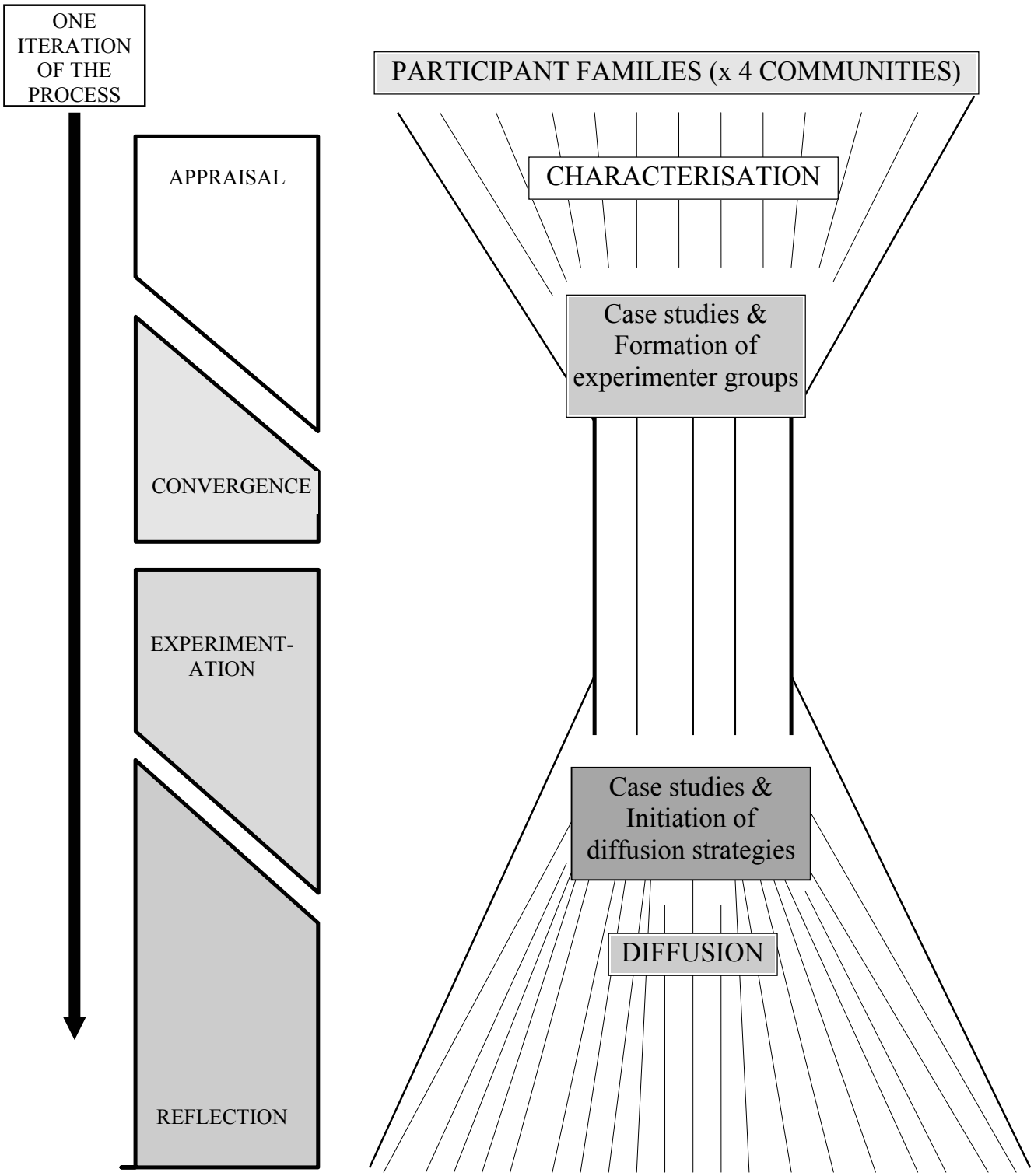
- facilitate and monitor the CE
- continue case studies and socio-economic research.

**Reflection**

- consider the results and implications of the CE
- diffuse the results and the process of the experimentation among more families
- diffuse new knowledge among families and communities.

Figure 15 shows the activities of the project's action-research axis within each of the participant communities. Here the emphases are upon facilitating the process of CE, collection of information to guide the on-station research, and establishment of the core CE groups that provided the basis for intra-community diffusion of the project outputs.

**Figure 15. The phases and the sequence of activities within each of the communities where the project was conducted.**



Each of the phases - appraisal, convergence, experimentation and reflection - is expanded upon separately below, with detailed descriptions of the tools used at each stage of the process. It is important to emphasise that these phases were not rigid periods of time where a strict series of methods and activities were carried out. However, they provided a useful and flexible structure for the research process.

## Appraisal

During the appraisal phase, contact was made with a cross section of families in each community. This contact was made through existing campesino groups working with local non-governmental organisations and/or grassroots organisations. Participatory appraisal methods, including semi-structured interviews, mapping, seasonal calendars and time lines, were used to gather the information needed to form a characterisation of family livelihood strategies and of crop and livestock husbandry. Information gathered was also used to delineate priority issues from the campesinos' perspective. Several campesino families were already familiar with the participatory research methods, which not only facilitated application but also validated or revoked the method's usefulness. Secondary information was also collected where available about the communities and the zones.

The different techniques used first during the appraisal phase are discussed below:

**Semi-structured Interviews (SSIs)**

Two SSIs guides were devised for the purpose of this research (Pretty, Guijt, Thompson, Scoones 1995 pp. 73-76 for explanation of the techniques). The use of this obvious and apparently simple technique cannot be underestimated in the participatory research process. The skilled and appropriate management of a semi-structured interview guide proved key to making the most of spontaneous opportunities that arose in the course of field visits. The guides also gave focus, without rigid control to farmer group meetings and facilitated the application of other PRA techniques. Further, the use of non-inductive questioning, a fundamental of SSIs, was crucial to facilitation of two-way dialogue between campesinos and researchers. Hence, principal emphasis was placed on the utility of applying the fundamentals of this technique in a variety of situations and circumstances with campesinos and their families, as opposed to its application as a whole interview guide.

**Mapping**

Mapping is a key tool to enable campesinos to engage in the PRA process. Mapping serves as a means through which the campesinos and researchers can understand problems and seek out

solutions. There are many variations on how mapping is carried out, for what purpose and how the maps can be used (see Shah 1995). In this research project, mapping was used to facilitate a reflection of animal husbandry methods within the village and crop production in the ejido. Thus, two mapping activities were undertaken, one in the ejido plots with individual campesinos, to define plots size and cropping methods and plants. A second type was carried out with groups of campesinos to define their village and identify types of animal housing and locations where dead animals are thrown. These maps served as a reference point in meetings between researchers and the group.

-

**PRA with a Gender Focus for Appraisal**

Attempts to understand gender issues were ongoing throughout the life of the project. However, efforts to understand gender divisions were given weight from the beginning, due to the affect they would have on experimentation. Specific PRA methods were also applied and developed during the research process to delineate gender aspects of crop-livestock husbandry. It is important to recognise PRA's limitations and shortfalls with respect to gender analysis. This has been particularly well documented by Crawley (1998) and Herbold Green (1998). However, there are also those that promote PRA for gender research, for example Sims, Feldstein & Jiggins (1994). Rangnekar (1993) concludes from a study in India, that researchers should look to participatory methods as a very likely means of understanding adoption and adaptation of feed conservation measures by women campesinos. In addition, when compared with the range of methodologies available, PRA does facilitate a focus on the ingenuity of campesinos (especially women) when adopting and adapting innovations in crop-livestock husbandry.

Gender division of productive tasks was at first explored within SSIs. However, variations in responses meant that a definitive delineation of gender based activities based exclusively on SSIs would not be possible. A general picture of the division of roles according to tasks was gathered from group interviews but further investigation was necessary to understand why women and men in some households shared certain productive tasks and others did not. The complementary PRA techniques of calendars, activity profiles and institutional diagrams were used to address the socio-economic, seasonal, and cultural factors influencing gender based division activities in campesino agriculture.

As will be observed in the following section, the use of PRA techniques for gender research provides some answers to the key questions raised in socio-economic literature review regarding intra-household differences. They are:

- what are the decision-making roles of men, women and children?

- what are the labour roles of men, women and children?
- who will accrue benefits from the innovation?
- who will manage any income derived?
- is knowledge shared within the household?
- how do these factors change over time?

**Institutional Diagrams**

Participatory institutional diagrams were attempted in all of the villages. The aim of using this method was to learn of the other institutions operating within the village, the areas in which they worked, their interaction and the extent of villager participation and how gender affects that participation. This contributed to information regarding social capital and the institutions and policies affecting the different villages.

Two methods were followed. The first delineated different associations according to gender-orientation i.e. all-male, all-female and mixed groups. The second was developed from the examples given by Pretty, Gujit, Thompson, and Scoones (1995), which distinguished between: (1) groups (by gender) working within the village without external involvement; and (2) those (by gender) which involved external organisations. This enabled the researchers to consider with the campesinos endogenous development and the networks or social resources that exist within the village in more detail. The diagrams were carried out on the floor or on a wall during meetings with picture cards representing the different organisations and institutions.

From a practical point of view, this method enables the researchers to locate themselves within the institutional context, to learn of other projects working within the same area and thus collaborate with other organisations. For example, complementary advice was given to CE group in Xohuayan regarding rearing methods for chickens donated by the National Institute for Indigenous Peoples. Importantly, this method also facilitates a reflection on time available to campesinos to participate in the various groups and in which groups attendance is "obligatory". For example, PROCAMPO meetings must be attended in order to receive the annual subsidy given to all ejidatarios (nearly 100 percent male organisation) by the state government. Another example is the compulsory attendance of school meetings in order for one's child to be considered for a grant.

**Well-being Calendars**

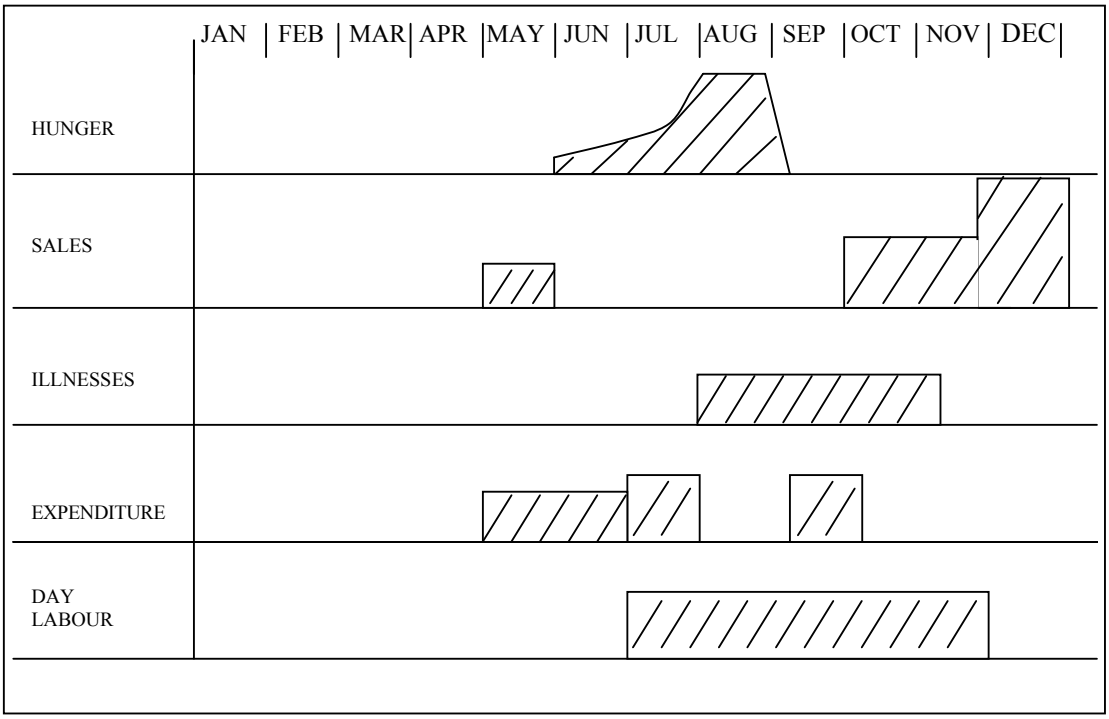
A series of well-being calendars were developed and carried out with each of the campesino experimenter groups and individual households, to investigate periods of stress and key

linkages between crops, livestock and well-being. Well-being was discussed around the following five categories: hunger, illness, expenditure, sales/production and off farm work as labourers. This was a variation on the technique as described in Archer & Cottingham (1997) and Wilde (1998). The calendars were usually carried out on large sheets of white paper and coloured pens were used to identify months and events.

The example of a calendar, provided in figure 16, helps to demonstrate how key linkages could be drawn from contrasting the well-being calendars with the PRA process generated in each village. The following linkages were later addressed in a more in-depth fashion with other techniques:

- levels of maize production and well-being: periods of stress related to purchase of maize, which those that produce sufficient maize for year-round consumption do not experience.
- the role and management of livestock, apiculture and crops in livelihood maintenance strategies: pigs can only be sold at a good price before maize shortfalls become a real problem, honey harvest provides cash in critical moments of year i.e. peak of dry season
- working as a labourer to fulfil basic needs such as providing food for the family.

**Figure 16. WELL-BEING CALENDAR X'CULOC**




Source PRA exercise carried out in 1998

**Profiling Activities, Productivity and Responsibilities**

Activity and resource control profiles are a means of delineating the roles of women and men in the dynamics of campesino agriculture. This technique assists in revealing the connections among activities, resources and benefits. The research process had generated conflicting information about gender delineated activities. Hence, it was felt that variations on this technique, as seen in Holcombe (1994); Slocum, Wichhart, Rocheleau & Slater (1995) and Narayan (1996), could help to consolidate and expand upon information about the productive activities of women, men and children and about the control of resources. The example shown in table 25 was carried out with picture cards.

**Table 25. Activity Analysis: Young Married Couple, Xohuayan**

| **Reproductive Activities** | **Woman** | | | **Man** | | | **Children** | | | **Control of income** |
|---|---|---|---|---|---|---|---|---|---|---|
| - Childcare | | X | | | x | | X Eldest Female | | | |
| - Prepare food & cook | | | | | (Only in case of need e.g. illness) | | (10) | | | |
| - Collect firewood | | | | | x | | X Eldest male (8) | | | |
| - Embroider | | | | | | | | | | |
| **Productive Activities** | | | | | | | | | | |
| Agricultural: | P | W | H | P | W | H | P | W | H | Man sells, wife |
| - Arable maize | x | x | | x | x | x | Eldest male child | | | looks after money. |
| - Milpa | x | x | | x | x | x | accompanies | | | |
| - Chilli | x | x | x | x | x | x | father after school | | | |
| - Minimum tillage | | x | | x | x | x | in all activities | | | |
| - Beans | x | x | x | x | x | x | | | | |
| - Ground nut | | x | x | x | x | x | | | | |
| Animals: | F | C | M | F | C | M | | | | Man sells cattle |
| - cattle | | | | x | | x | | | | and pigs. Gives |
| - poultry | x | x | x | | | | | | | money to wife to |
| - pigs | x | x | | | | x | | | | look after. Poultry not sold |

P = Plant, W = Weeding, H = Harvesting, F = Feed, C = Clean, M = Manage

The profiles carried out with individual families were complimented and contrasted with gender analyses by the campesino experimenter groups about the ownership of resources, using ready-made picture cards. The groups were asked who (woman, man, or couple) owns each resource depicted on the cards. The results of the application of this technique with farmer experimenter groups in each village, are presented below:

**Table 26. Gendered Possession of Resources in Four Villages in the Yucatan**

| Who owns? ➢ Village | WOMEN | MEN | FAMILY/COUPLE |
|---|---|---|---|
| MAHAS | Chickens and hens<br>Clothes<br>Sewing machine<br>Home-garden vegetables | *Bicycle*<br>Steers<br>Bees<br>Pigs | *House* and children<br>*Money*<br>Crops<br>Jewellery |
| XOHUAYAN | Chickens and hens<br>Clothes | *Bicycle* or motorbike | *House*<br>*Money*<br>Crops<br>Sewing machine<br>Steers<br>Bees<br>Pigs<br>Jewellery |
| XCULOC | Chickens and hens<br>Clothes<br>Sewing machine<br>Jewellery<br>Home-garden vegetables | *Bicycle*<br>Crops<br>Bees | *House*<br>*Money*<br>Pigs |
| SAHCABCHEN | Jewellery<br>Sewing machines | *Bicycle*<br>Truck<br>Bees | *Money*<br>*House*<br>Maize & associated crops<br>Pigs<br>Poultry<br>Vegetables<br>Steers |

Where villages coincide, possessions are highlighted in italics. These techniques were carried out both within the appraisal stage and within the CE phase, with more detailed research.

**Gender disaggregated Activity Calendars**

In regions with distinct seasonal patterns of agricultural production, gender-disaggregated calendars can provide the basis for exploring interlocking gender and seasonal related constraints to adopting new innovations in crop-livestock interactions (see Sims Fieldstein & Poats 1994).

Gender-disaggregated activity calendars address issues of gender based labour division in each village. These calendars were completed, with the campesino experimenter groups, in the belief that a heterogeneous picture would emerge about gender-disaggregated activities that would enhance and simplify our understanding of women and men's roles in crop-livestock interactions in these villages. The calendars completed within groups were useful in

providing a general picture, but when analysing the separate calendars of different households, contrasts emerged. For example, working as a labourer in critical periods is not a universal activity, nor is the necessity to buy maize or sell animals in the summer months widespread. As such, the need to insert the analysis of the differences, according to socio-economic status of each household, was clear. The interlocking of such data is demonstrated in the following section on wealth, well-being ranking and activity profiles.

The calendars completed by a male farmer group and a female farmer group, in one village, are presented here in Table 27.

**Table 27. Gender Disagregated Calenders: Xohuayan**

| **Women's work** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Month** | **Jan** | **Feb** | **Mar** | **April** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** |
| **Rear pigs & poultry** | x | x | X | X | X | X | x | X | x | X | X | X |
| **Sew** | x | x | X | X | X | X | x | X | x | X | X | x |
| **Clean** | x | x | X | X | X | X | x | X | x | X | X | x |
| **Cook** | x | x | X | X | X | X | x | X | x | X | X[6] | x |
| **Child care** | x | x | X | X | X | X | x | X | x | X | X | x |
| **Collect firewood** | During the meeting, no woman stated that she collected firewood, but afterwards one woman commented that she did. | | | | | | | | | | | |
| **Shell maize** | x | x | X | X | X | X | X | | | | X | x |
| **Pack beans** | | | | | | | | | x | x | X | |

| **Men's work** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Rear steers**[7] | x | x | X | X | X | X | x | X | X | x | X | x |
| **House-building** | x[8] | | | | | | | | | | | x |
| **Collect firewood**[9] | X | x | X | X | X | x | x | X | X | x | X | x |
| **Slash** | | | | x Caña | x | | | | | | x If older forest | x |
| **Burn** | | | | X | X | | | | | | | |
| **Sow**[10] | | | | | x | x | | | | | | |

[6] November is an important period and much food is prepared. Unmarried daughters cook when their mother is in the milpa.
[7] Not considered a hard job.
[8] In dry season the roof has to be repaired in time for the maize harvest in February
[9] Responsibility of male children, although adult men also help.
[10] Traditional maize planted at beginning of June and improved varieties between 15-20 May: first rains.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | milpa chilli | | | | | | | |
| **Weeding** | | | | | | x | | X | | | | |
| **Harvest**[11] | | x x maize | | | | | | ------chilli ---------- -----squash---------- | | | | |
| **Cut & bring forage for pigs**[12] | x | x | X | X | X | x | x | X | X | x | X | x |
| **Apiculture**[13] | | | | | X | x | x | X | X | x | X | |

x = normal work
X = intensified work-load
Caña = remnants of previous maize crop

The calendars were done with picture cards (most women are illiterate and monolingual in the four villages). Each card showed the different activities that are part of campesino livelihoods, some of the drawings caused much laughter and thus served as an excellent ice-breaker.

The results of the gender analysis have been presented in table 7.

## Convergence

The process of participatory research generally leads to a convergence of ideas and aims between researchers and campesinos. In this project, convergence resulted and proved to be a difficult but fruitful phase. Families, who were interested in the theme of crop/livestock integration and were willing to provide case study material, were defined and CE groups were formed according to their goals. Each group then identified themes for experimentation. In this phase, researchers attempted a more in-depth approach to understanding the socio-economic context and the case studies were also initiated.

PRA tools are recognised as successful during the characterisation phase of projects but their use in planning and decision-making for campesinos is less well known. The need to find appropriate and useful participatory methods for this phase was discussed with other researchers and campesinos in a network, established in Mexico to discuss opportunities and difficulties surrounding CE (Red de Experimentación Campesina, 1998). Literature and ideas were shared, as were individual experiences but each case was different and no "recipe" was produced. Inevitably, the approach used to achieve the goals of this phase was experimental

[11] Some families contract labourers, others do not.
[12] Pig rearing is women's work.
[13] Apiculture is only difficult when the honey has to be extracted.

and iterative yet firmly based in the PRA tradition. The methods and approach used are explained below and in chapter four.

**Meetings, Dialogue and Brainstorming and Key Questions**

In each village, the campesinos who had particpated in the appraisal stage were invited to a meeting where researchers determined their interest in forming a CE group that would specifically try out innovative animal husbandry techniques. The research team presented this idea to them. Brainstorming was used to focus in on why they would want to form their own group and how it would operate.

In all four villages, animal health was a priority issue for the campesinos. While health issues did not fall explicitly within the research team's remit, for collaboration it was felt that an attempt could be made to respond to their questions about poultry health. The opportunity could then be used to link the issues of health to problems with their diet. If this were to work, then the collaboration would have a longer-term future given the research's goal of investigating crop-livestock interactions. Hence, because of the dialogue in meetings, the researchers offered animal health workshops in each village, open to all villagers. The workshops and their results are expanded upon in chapter four.

## Socio-Economic Tools Developed and Applied within the Convergence Phase

**Well-Being Rankings**

In order to discern local perceptions on wellbeing and the socio-economic status of the participants, the researchers proposed to the groups their need to carry out techniques related to understanding wellbeing in their village. Due to the sensitive nature of this technique (for full explanation, see Grandin, 1988) it was decided not to attempt a ranking exercise until the research process with the farmer groups was established. Given that visits to farmer research groups were spaced at monthly intervals, a full year passed before well-being ranking was tried.

It was decided to use some slight variations on the technique as suggested by contributors to RRA Notes (May 1992) 'Special Issue on Applications of Wealth Ranking'. As already mentioned, a series of wellbeing calendars had been developed with villagers and as such the concepts of wealth and wellbeing discussed with them. This provided local terminology for the concept of wellbeing as well as an introduction to the subject area explained as: a need to

understand how people live in order to improve the researchers work in the village. The concept of wellbeing was preferred to that of wealth as it encompasses a diversity of factors that influence a family's or person's status.

It was important to understand local definitions for the household unit to be ranked. Research suggests that the most appropriate unit in many societies is the head of the extended family. However, based on discussions with male and female campesinos the nuclear family is what they consider as constituting a household. This division was validated during the ranking when parents and their married children, despite living in the same home garden, were not ranked in the same status.

Limitations of the technique as applied in this project were based on the late application and the sensitivity of the subject matter:

- As the CE groups were already established when the ranking was undertaken it was difficult to then define the impact of experiments on a family's wellbeing. Furthermore, some experiments were very small-scale, for example producing earthworms to feed chickens. If earthworms increase egg production, this would not be sufficient to move a family up the well-being scale.
- Despite applying the technique when solid relations had been established, there existed some reticence on the part of the campesinos to identify families as pertaining to one wealth group or not.
- The lists of names were generally provided by the local authority. On one occasion, the cards contained the name of a man who had recently died and his widow was carrying out the ranking.

Despite these criticisms, use of the technique did provide a series of important qualitative and quantitative criteria for measuring poverty and wellbeing. These are commented upon in the chapters two and four.

**Animal Inventory**

The animal inventory was a technique developed as a result of the researchers' interest in studying the animal population levels and the quantity of maize dedicated to animal feed and human consumption. The tool began as a list (number of chickens, turkeys and pigs and quantity of maize given) and the quantity was asked of each farmer. However, it became apparent that the campesinos have different conceptions regarding types of animals (chicks, small chickens, chickens, hens for example) and a more detailed inventory was developed according to their own categorisation. Many of the campesinos are illiterate. Hence, hand-

drawn pictures of the different animals were used. The inventory was conducted every month, and the differences between one month and another (consumption, deaths, purchases) were listed and identified. This takes about 10-15 minutes for a group of 8-10. It was carried out between August 1998 until October 1999, with 30 households from the four villages.

The purpose of the technique is to provide more detailed information on maize consumption and on the time of purchase. The intention was to use that information as a discussion theme with campesinos, to facilitate the identification of feed shortage periods, and how trade-offs are made between allocating maize to the family or 'investing' it as animal feed. Due to the quantity of the data generated, it was not initially analysed directly with the participants. Instead this was carried out by the researchers who processed the information using spreadsheets, and developed easy to understand tables, which were then presented to the groups at six monthly intervals. Livestock population levels and animal feed quantities were graphed for each household, and explained. Questions were then asked as to what was understood from the graph, what had been learnt, and what this implied for the management of livestock. The graphs proved to be difficult to interpret for some households in the first village visited and they were later adapted in order to be more visually apparent, which had better, though still mixed results. Campesinos saw the analysis a second time when they were presented at the village level (rather than the results of individual households). They also saw them at the end of the CE process, when results were relayed to the CE groups (see section on workshops in chapter four).

The following limitations were found with this technique:

- when filling in the table, campesinos were often confused over type and age; the pictures were not sufficiently clear for all to understand,
- changes are recorded one month after event,
- problems arise over how much maize is consumed by the family and animal species,
- a limited number of people can participate in the technique for a year, thus it is difficult to generalise about the results for the whole population,
- campesinos did not want to note down chicks' births due to their high mortality and as such did not want their inventory to have sudden "drop" in numbers,
- even numbers are difficult for some campesinos to write,
- improved understanding by campesinos of population dynamics was not achieved through this technique. This could have enabled a more integrated approach to animal husbandry,
- an analysis of entries and exits was not undertaken due to the researcher's focus on feed and also lack of time. However, this would have been useful for the campesinos.

## Experimentation

Once CE groups were formed the challenge lay in how to facilitate and monitor the experiments and maintain momentum when experiments "failed" or became "uninteresting". Again, this proved a methodological challenge for the researchers unused to "uncontrolled" experiments and campesinos unaccustomed to words such as experiments and monitoring to describe something they are always doing.

Furthermore, in this phase the approach to understanding the socio-economic context was intensified and the case studies were continued.

The process and techniques used to enable campesino experimentor groups are described in chapter four.

## Socio-Economic Tools Developed and Applied within the Experimentation Phase

**Maize Scarcity Research**

Data from the animal inventory revealed that some households suffered maize shortages and began to buy maize earlier in the year more frequently than other households. As harvest begins in October, some households suffered severe shortages and began to buy maize in April. The researchers considered it important to understand the strategies adopted during such periods of maize shortages in order to determine how livestock husbandry was affected, and indeed the role that it played. Semi-structured interviews were carried out with two households in Xohuayan and questions regarding the month's in-comings and outgoings were asked. Given the sensitive and extractive nature of the information, a technique was devised which could be used with the household, and was only conducted with households where a great deal of trust had been developed. A simple in-comings-out-goings flow diagram was drawn with the house at the centre and arrows marking inflows from sales, wage labour, loans etc. on one side and outgoings on the other. The technique was carried out with four households in three villages for one to seven months.

Results were analysed in different ways. Flow diagrams were developed which show the main in-comings and how they were utilised. In addition, quantitative analysis revealed approximations of the role of livestock sales in the household budget during this period. However, quantitative analysis was limited, given the gaps in the data, as interviews were designed as far as possible not to be extractive and thus detailed complete budgets were not developed.

**Participatory Budgeting**

Participatory budgeting was carried out in two villages. It was introduced to the project following a workshop in February 1997. It was carried out with two households in Sahcabchen in order to consider the cost of pig rearing. As a participatory tool, it draws upon campesinos conceptions and thus, modifications occurred on application. The tool was time-consuming (four hours each application) and thus was not used for the same subject on another occasion.

Its second application was with the Men's CE group in Mahas, in order to compare the costs and benefits of the traditional Milpa system and the Minimum Tillage System for the agricultural year 1998/9. Construction of the budget sheet was conducted with the farmer group and, due to time constraints, data was analysed by the researcher and then presented back to the group. A number of changes and suggestions were made at this stage by campesinos (such as placing a local wage value on farmer's labour) which were then brought into the budgeting exercise and calculated. The exercise contributed to the process of defining the advantages and disadvantages of the two agricultural systems (within CE Mahas group manual), and the livelihood budget (see below).

**Livelihood Budget**

The livelihood budget was conceived in February 1999 to contribute towards the goal of ex-ante and ex-post socio-economic indicators of the impact of livestock integration in family livelihoods. The aim was to develop a quantitative tool for indicator definition and to process indicator data in the future. It consisted of a spreadsheet which considers livelihood activities (agriculture, livestock and other enterprises), inputs (labour, cost of inputs) and outputs (production for consumption and sale). Indicators developed are those of stock levels, productivity levels, income diversification, degree of market involvement and potential wellbeing indicators.

The tool was used for two households within Mahas. Data was collected in a variety of ways. Some information regarding prices of livelihood outputs (crops, livestock, other enterprises) and inputs was already known and so was directly inputted by the researchers. The participatory budgets (see above) were used to provide more detailed information regarding costs, labour and production levels for the two hoousehold's agricultural livelihood activities. The animal inventory (see above) contributed to data regarding livestock livelihood activities (the quantity of animals per month, the quantity of feed and types used and the consumption and sales of different animals each month). Modified (detailed) activity calendars drew upon

labour requirements for other enterprises (such as honey production and handicraft) and in particular months and time dedicated to wage labour. Wellbeing calendars were used to provide information regarding other sales and expenditures during the year. Any remaining data gaps were filled through informal questions within semi-structured interviews with both households.

The budget has contributed towards the definition of indicators (see below). It has played an important role in terms of the prediction of the potential impact of different agriculture/livestock technologies to households' livelihood outcome (using the two households' budgets). However, due to the information demands, research has not extended beyond two households. Thus, it has not been used to produce data regarding the impact of the technologies to different households.

## Reflection

The time limit of the research collaboration was stressed from its beginnings in order to avoid any possible sense of deception or misunderstanding when the project arrived at its conclusion. Hence, in the project's final year a process began through which to identify methods of considering the results and implications of the CE. The results and the process of the experimentation could be diffused among more families, and new knowledge could be diffused among families and communities.

Below, the techniques developed and used in this phase are explained. The results of this phase are expanded upon in chapter four.

**Consultative Evaluation**

A consultative evaluation was carried out at the end of the CE process in order to meet a number of different objectives:

1) to evaluate the impact of the experiments as perceived by the families,
2) to record and share campesino's experiences between the different CE groups, and beyond,
3) to investigate the appropriateness of the technology.

The evaluation was conducted, in conjunction with the recording of oral histories of experiments, for CE group books (see below).

Interviews were carried out in the final stage of the project during the last two visits made by the researchers to the villages. Semi-structured interviews were carried out at the individual

household level so that more detailed, specific accounts of experiments could be recorded. A general format for interviews was developed (applicable to all experiments) where open questions were asked regarding the different themes outlined above. Examples include:

- Within the experiment of 'x',
- When did you start?
- What happened?
- Why?
- What happened after that?
- Why (time line drawn-see below)?
- What benefits have been achieved?
- What problems have you encountered?
- How has experiment 'x' affected your time?
- How has participation within the CE group helped you to do experiment 'x'?

Within the interview, a second researcher was required to write the responses. In certain situations, a translator was needed.

Concurrent with the participatory methodology, a visual research tool was selected and, as far as possible, local conceptions were used rather than those of the researchers. The main interview themes emerged from a study of the monitoring process of monthly meetings (see table 28 for an example) and included: problems experienced and if overcome, how, benefits realised, and how the experiment had affected the household's workload. In addition, it was important to use a tool, which guided interviews rather than structured them. The tool used had an 'open' style of questioning and was subsequently referred to as a 'time line' (WRI & GEA, 1993). This began with the start of the experiment, and traced the history of the experiment. Although the same technique was developed for all villages, it was applied differently according to literacy and education levels of the informants, time available etc. An example is shown below:

**Table 28. Timeline: Household in Xohuayan**

| 1997 | 1998 | 1999 |
|---|---|---|
| 12 Oct: Sold steers, part pays for pig-pen | Jan - Feb: fed maize, less Mucuna forage and squash | Jan- Feb: Forage and maize diet. Sold Mucuna bean. |
| 13 Oct: Started building pig pen | May: Fed Mucuna bean and maize. Only papaya leaves as forgae. Piglets born | March - Sept: no home-produced maize, all purchased |
| December: Put four pigs in pen: fed maize and Mucuna forage | June - October: More forage becomes available as rains begin | Sept - Nov - Maize and forage. |

A number of difficulties were experienced within the evaluation interviews. Researchers perceived the experiments differently to the campesino experimenters. For many of the experimenters, the experiments were grouped together and when, for example, 'Mucuna' grown in the backyard' was discussed and a timeline was drawn, experimenters discussed the benefits of 'feeding Mucuna seeds to livestock'. Thus, data had to be disaggregated after the evaluation. A translator was essential (but unavailable) in at least two of the four villages, ideally a team of three was needed, in order to: (1) ask the questions, (2) draw the timeline, and (3) note the interview. This caused practical problems. In one village, Mahas, the participants preferred to conduct the initial interview as a group, this posed difficulties in discussing individual experiments in sufficient depth. Interviewees were revisited the following day in order to elaborate on some experiments. The timeline technique worked better in some villages than others – it worked very well with participants who spoke little Spanish (generally women) and where education levels were lower. Thus, the researchers had to adjust to the different interview situations.

The results were systematised by transcribing the interviews, formatting them according to what happened, benefits, problems, changes to workload in line with the interview. Interviews for each experiment were grouped together and comments aggregated according to village and Stratum; and interpretations were then made and the analysis conducted.

In order to conduct a more quantitative analysis, in the last CE meetings, participants were asked about all the experiments: whether they had tried them at all, tried them once only or continued to use them. This was analysed by village, and socio-economic group (see chapter four). No time component was included in the analysis. This enabled researchers to evaluate the adoption rate of the different experiments.

The analysis of the evaluation results revealed the following limitations of the data:

- the sampling process was opportunistic. It was hoped, prior to the interviews, that a 'sample' of the different socio-economic stratum per experiment would be possible. However, in the field it was more a case of who was available and for how much time
- the small 'survey population' (39) means that is difficult to generalise from the results
- the open style of questioning produced highly diverse answers that proved to be difficult to systematise and analyse. There were no 'yes' 'no' answers – they were specific and descriptive responses. This adhered to the project's participatory methodology but means that it is difficult to give standardised results

- there was a tendency within the interviews to concentrate on the positive rather than the negative. Questions were asked regarding the experiments that *were* tried and the technologies that were adopted, rather than those that were not – and why not. Thus, the constraints to adoption and reasons for abandonment/rejection had to be inferred
- interviews were only held with CE participants. Consequently, it was difficult to form an idea of the diffusion of the projects. The evaluation will be followed up with a more detailed survey to look at adoption/adaptation and diffusion in 2000/2001. For the meantime, other methods were developed such as counting the number of chicken houses in Xohuayan amongst non-CE participants that have been built since the completion of CE participants' chicken houses. In addition, Interviewees were asked whether they knew of other people who have started to experiment.

However, the evaluation gave the researchers rich insight, for each socio-economic stratum, into the level of adoption and the problems and benefits experienced. Furthermore, the evaluation process achieved the first two objectives to a certain extent but failed to facilitate campesino-campesino learning. Thus, a different complementary technique was developed to meet these needs: CE books.

**CE books**

Oral histories (Mikkelsen 1995:80) were combined with the consultative evaluation so that experimenters described their experiences, prompted by the themes and questions outlined. During CE group meetings in October 1999, the idea of recording experiments in a book was suggested to the groups by the facilitators, and positive feedback was received. The books, named 'Experiences with Experiments', were compiled for each village, over a three-month period. They consist of pages dedicated to particular experimenters, with photographs of the experiments and a written section about their individual experiments. Participants decided on the experiments included and on how this was done. A manual compiled by the CE group in Mahas was used to provide an example. In two of the villages, individual oral histories were initiated immediately within the group meetings, for the others, interviews took place within individual households. All of the photographs were taken with the individual households. The recorded histories and photographs were then processed and compiled in the form of a book. The following month, these were returned to the villages to receive feedback. Suggested changes were made, and in the group's final meetings in February 2000 copies of their village book were given to each participant.

The books provided a tangible product for each campesino at the end of the CE process. They were economic to produce and were used by the campesinos at the concluding workshop to

share their experiences with other campesinos. Thus, the books contributed to the impact evaluation of the experiments, as perceived by the families. They also served to record and share campesino's experiences between the different CE groups, and beyond. In addition, they act as a product of the evaluation interview, and eliminate the otherwise extractive nature of the interviews. Such documents (especially those including photos) motivate a certain amount of pride in the work achieved. They were presented by the campesinos as part of the final workshop in March 2000.

**Campesino-Campesino Exchanges**

Campesino to campesino is a well-known and trusted method of sharing, diffusing and generating knowledge and experience (see Bunch, 1985). From the beginning of this research project, annual exchanges were organised of farmer's groups that were testing innovative farming methods or animal husbandry techniques, in order to stimulate interest in the concept of CE. To conclude the project, meetings were held between different farmer experimenter groups so that knowledge and experiences could be shared and conclusions could be drawn. For example, women from the Mahas CE group visited the CE group in X'culoc and presentations were given of the experiments they had carried out to date. The same group, Mahas, initiated a workshop in a neighbouring village Poop, which they visited and gave a presentation of remedies for common livestock illnesses. In addition the Xohuayan men's group visited the Mahas men's group to learn about the minimum tillage farming practices that they were carrying out there. It was found that these exchanges not only contributed to the capacity-building process and increased group solidarity but also encouraged campesinos and added impetus to the CE process.

**Participatory Evaluation of the On-Station Experiments**

Thirty men and Thirty-five women from the four participating CE villages came to the FMVZ in Merida, during October 1999 for a one-day visit. The objective was to show CE participants the work within the faculty and obtain feedback from campesinos regarding the experimental system of a rotation of crops with and without animals. The evaluation consisted of three stages: 1) a visit to the field site; 2) discussion groups regarding what campesinos had seen; 3) presentation of ideas generated by each discussion group. Participants were divided into all-male and all-female groups. Within discussion groups', questions were asked such as:

- what did you see in the field-site?
- what were the aspects that you liked?
- what were the aspects you did not like?

Feedback generated was systematised and analysed and is included in the on-station research results.

## 3.3 Research tools used within campesino experimentation

### Sustainable Livelihoods Framework

The sustainable livelihoods theme was first introduced into the project by the incorporation of the Ellis framework (Ellis, 1998). This is considered a useful conceptual framework to analyse socio-economic elements of the project. As the model was developed by DFID and became more accessible (Carney, 1997; Livelihood Guidance Sheets, 1999), it became integral to the project. It is congruent with many of the project aims, given its' people-centred approach and emphasis on participatory and sustainable development[14]. A holistic model enabled researchers to consider agriculture and livestock livelihood activities, not as an isolated sector but rather, within the context of other livelihood strategies. Micro-macro linkages within one model, allowed analysis of macro-level policy and institutions and their effects on livelihood options.

The framework was used to write four 'Villages Livelihood Reports', a 'Transforming Structures and Processes Report' and a 'Synthesis Report'. Introduced in the mid-term of the project, it provided a useful exercise in locating existing information within a model, and the identification of information gaps. The different information sources are listed in table 29 below.

The sustainable livelihoods theory also provided a starting-point for two tools which have emerged: the Livelihood Budget (see above); and the other is that of the Asset-Function Framework (Dorward, Anderson and Clark, 2001) which is incorporated within the Synthesis Report.

[14] Sustainable development is taken to mean environmental, economic, social and institutional

**Table 29. Information sources used within Sustainable Livelihoods Model**

| Sustainable Livelihood Concept | Information Sources |
|---|---|
| Vulnerability Context | • Secondary information, govt. statistics<br>• Problem trees withCE groups<br>• Timelines<br>• Historical agricultural calendars |
| Natural Capital | • Secondary information, local NGO reports<br>• Transects<br>• Soil mapping<br>• SS interviews (ejido president) |
| Physical Capital | • Secondary information, govt. statistics, NGO reports<br>• Observation<br>• Mapping<br>• SS interviews (villagers, teachers, clinic staff) |
| Human Capital | • Secondary information, govt. statistics, NGO reports<br>• Activity calendars (men, women)<br>• Decision-making calendars<br>• Wellbeing stratification<br>• SS interviews (villagers) |
| Social Capital | • Secondary information, govt. Statistics, NGO reports<br>• Institutional diagrams<br>• SS interviews (villagers) |
| Financial Capital | • Secondary information, government statistics<br>• Participatory budgets<br>• Livelihood budget<br>• Maize crisis flow diagrams<br>• Wellbeing stratification<br>• Wellbeing calendars |
| Transforming Structures and Processes | • Secondary information, govt. Statistics, academic papers, NGO reports |
| Livelihood Strategies | • Secondary information, NGO reports<br>• Activity calendars<br>• EC Groups monitoring reports, experience<br>• Wellbeing stratification<br>• SS interviews |
| Livelihood Outcomes | • Wellbeing stratification<br>• Wellbeing calendars<br>• Gender delineated ownership of resources |

(*Sustainability* as outlined in DFID Sustainable Livelihood Guidance Sheets 1.4, 1999).

### 3.4 On-station research

Conventional experimentation into feeding poultry and pigs with Mucuna, and in systems appraisal of crop x livestock interations are presented in Chapter five.

In the next chapter, we describe how participatory M&E approaches were used with the CE groups to facilitate the learning process for both participants and researchers.

# 4 PARTICIPATORY MONITORING AND EVALUATION WITH CAMPESINO EXPERIMENTER GROUPS

## 4.1 INTRODUCTION

The primary function of participatory monitoring and evaluation (PM&E) in this project was to serve as a process through which the CE groups and researchers could understand, analyse and learn from the experiments. Researchers found during the appraisal stage, that participatory methods encouraged a focused two-way dialogue on the issues related to the experiments, whilst encompassing wider themes that affect the agricultural systems. Further, as commented by Davis-Case (1989), monitoring and evaluation of objectives and indicators should be according to a community's means and wishes, facilitated by outsiders who can use participatory tools. As a natural consequence of a positive experience with participatory appraisal, and due to a commitment to participatory research, the methods were tried for monitoring and evaluation. A selection and adaptation of methods for participatory monitoring and evaluation were made by the researchers as it was felt that no single approach (for examples see Ashby, Beltran, Gracia, Guerrero, Quiros, Roa, Trujillo and Escobar, 1993-1996; or Davis-Case, 1989) fitted the requirements of the project in gaining an understanding of the groups and of their cultural context.

A more holistic and farmer-participatory approach is generally considered essential to cope with the problems presented by the diverse and complex systems, common to small-scale farming, which conventional on-farm experimentation has not been able to address adequately (Ashby, 1986, Lightfoot and Noble, 1993). Furthermore, evidence exists to demonstrate the capacity of farmers, especially resource poor farmers, to experiment, adapt and innovate (Chambers, Pacey and Thrupp, 1991). The use of participatory methods in monitoring and evaluation facilitates the reflection and analysis of the innovations that campesinos test, whilst continuing to encompass factors beyond the crop-livestock interaction that influence the adoption and adaptation of innovations. Monitoring should be process and impact orientated (Gosling and Edwards, 1995). Thus, the emphasis of this project's PM&E was on what the campesinos set out to do and what they achieved. However, the context within which the goals were set were of utmost importance, hence objectives were constantly reviewed and revised by the campesinos.

The research team's protocol was also concerned with gender as an influential factor in crop-livestock interactions, and they wanted to work more closely with the women in this area. It should be noted that in three of the villages (Xohuayan, Mahas and X'culoc) women-only

groups were established in order to facilitate space for women to vocalise their interests and opinions. This was considered necessary given the nature of gender relations in traditional Mayan villages (Nimis, 1982). Furthermore, as Ciappe's (1994) results of studies with Minnesota farm women emphasise, women must be recognised as key actors in the construction of sustainable agriculture systems and that attention must be paid to women's specific views, ideas, needs and concerns.

The process and experience as a means through which the campesino experimenter groups monitor and evaluate their experiments in conjunction with researchers is presented here. The CE groups in the villages of Mahas, Xohuayan, X'culoc and Sahcabchen were established and developed using an interactive participatory approach. However, due to various factors, the process differed in each village, and this will be highlighted so as to demonstrate how the development of trust relations between researchers and campesinos is crucial to initiating and continuing a shared learning process. This chapter will demonstrate the importance of a flexible use of participatory methodology in facilitating the development of CE groups and enabling PM&E. The results of this process will be presented.

## 4.2 THE PM&E PROCESS WITH THE FOUR CAMPESINO EXPERIMENTER GROUPS

### Invitation to form groups: Getting to know each other's objectives

***Techniques used: brainstorming, problem identification, seasonal feed availability calendars and defining concepts i.e. campesinos and researchers sharing and developing definitions of concepts such as objectives, experiments, monitoring, organisation.***

The researcher's specific objective in all four villages was to seek out their interest in forming a group that would specifically try out innovative animal husbandry techniques. After a series of dialogues and negotiations between two local development NGOs and researchers, a common ground was found. Both parties felt a relationship between the two could be useful for the campesinos they worked with and the researchers could carry out their project objectives. In three of the villages, the research team was introduced to campesinos who had or were still collaborating with the NGO, and presented their research protocol "Optimising crop-livestock interactions in small-scale low input agricultural systems". In the fourth village, Xohuayan, the invitation to work with a women's group evolved from a dialogue with an all-male campesino group.

## Brainstorming

In the dialogues that followed between the researchers and the campesinos a list of the campesino's priority issues was drawn up:

- in Mahas, the women identified health problems affecting their poultry.
- in Xohuayan, the women wanted to enclose their poultry and saw the formation of a CE group as an opportunity through which this could be achieved.
- in Sahcabchen, where the group was predominantly male, campesinos reflected upon their individual pig rearing methods and decided to monitor the feed and weight of their pigs.
- in X'culoc the women wanted to learn and share experiences with pig and poultry husbandry amongst themselves and with their peers.

In each village, this led to a drawing up of objectives. In table 30, their objectives and experimentation options based on those objectives, are presented. Defining objectives in terms of PM&E was important as it provided the basis upon which the CE groups monitored their experiments. In all the villages, the campesinos' aims and experiments were firmly based on animal health and feeding issues. The campesinos' emphasis on health issues initially caused the researcher to re-think their research strategy in the villages as it was not a priority area for the project. How this was dealt with is explained in chapter three.

It should be noted that calendars identifying seasonal differences in feeding strategies were also used in conjunction with brainstorming sessions, to identify and stimulate ideas for possible experiments.

As the group in Xohuayan had defined one specific experiment (construction of hen houses), the themes based on problems and benefits of the experiment (see table 31) were developed before embarking upon the construction of hen houses. The other CE groups discussed potential problems and benefits during the process of selecting things to try.

**Table 30. Defining Experiments in Three villages**

| Objectives | Things to try out |
|---|---|
| | **MAHAS** |
| • Learn how to raise animals differently.<br>• Learn how to prevent illnesses.<br>• Have healthy and pretty animals. | • A clean hen-house<br>• Use medicine to eliminate parasites<br>• Vaccinate<br>• A clean hen house with a clean feed tray<br>• Change their sleeping pole<br>• Give clean drinking water<br>• Do not allow ill animals near healthy ones.<br>• Make a floor in the hen house and feed the hens well.<br>• To prevent illness, we have to ensure cleanliness in their hen house and their feed, separate ill birds from healthy ones and not allow them to eat together.<br>• A diet of maize complimented with Mucuna and green leaves (forage).<br>• Vermicompost. |
| | **X'CULOC** |
| • Learn how to rear healthy and pretty animals<br>• Learn how to improve feed for poultry<br>• Have pigs that grow<br>• Learn what to do with ill animals<br>• Learn about cystercicosis | • Health problems to monitor and analyse in group: cystercicosis, parasites, clean water, dirt, colds, diarrhoea, sudden death<br>• De-worming with local methods<br>• Feed with local forages, bebida, maize, squash, Mucuna<br>• Compare differences in animals according to origin and husbandry |
| | **SAHCABCHEN** |
| • Raise pigs in the fastest and most economical method.<br>• Find the best way in which an animal adapts to feed, climate and pen<br>• Compare creole with cross-breads<br>• Compare large pigs with small ones with one type of feed<br>• Have a single plot of Mucuna<br>• Have Mucuna nearby<br>• Feed without chemicals<br>• Have creole pigs<br>• Have healthy animals | • Pigs free-roaming<br>• Pigs in corrals<br>• Pigs tied-up<br>• Measure how much pigs eat<br>• Weigh pigs<br>• Pig tied-up fed with Mucuna |

**Table 31. Working through the experiment before testing: hen houses in Xohuayan**

| BENEFITS | POTENTIAL PROBLEMS | HOW CAN THEY OVERCOME THESE PROBLEMS? |
|---|---|---|
| • Poultry will not eat chilli seedlings.<br>• Poultry will not get wet<br>• Poultry will not die<br>• Poultry will not enter their homes<br>• Excrement can be collected<br>• Poultry will not be eaten or attacked by other animals<br>• More eggs will be collected | • More work as they have to be fed more frequently<br>• The poultry may get ill<br>• The poultry may not be fed enough | • Ask their families for help<br>• Mix chicks with turkey chicks so they teach them how to eat<br>• Women get up earlier<br>• Attend poultry health workshop<br>• Give the poultry lemon with water and other remedies<br>• Plant more Mucuna<br>• Collect forage<br>• Plant forage |

## Monitoring Experiments

***Techniques used: monitoring benefits matrix, discussions in monthly meetings, group visits to experiments in home-gardens and other villages, weighing pigs, brainstorming and animal health workshops***

An example of the monitoring process followed can be observed in the case of the CE group in Xohuayan. The benefits (as seen in table 31) anticipated were represented in drawn images and presented in a matrix format by the researchers at the monthly meetings, following the construction of the hen houses, and were analysed with the campesinos. As seen in a copy of the matrix, presented here in table 32, two months after the construction of the houses, the women were very concerned about the absence of egg production and many blamed the enclosure of their birds. This type of straightforward monitoring process gave the campesinos early opportunities to discuss problems in-group, and to seek out possible solutions with other campesinos and the research team. However, it proved difficult to revise the benefits on a monthly basis due to the quantity of topics to be dealt with at the monthly meetings and eventually they were checked every 3-4 months.

**Table 32. Matrix for monitoring benefits of hen-houses in Xohuayan**

| Benefits to be monitored | October | November | December | January |
|---|---|---|---|---|
| **Poultry will not eat seedlings** | Seedlings unharmed | | No seedlings planted | |
| **Discuss in group why and how many of our birds became ill, die or are aeten by other animals** | • Fowlpox identified as important subject<br>• Researchers discuss vermi-compost | • Researchers share information on how to avoid and treat fowlpox<br>• Why hens stopped laying: housing or change in diet? | | • Flea problem on hens discussed |
| **Poultry excrement to be used for chilli seedlings and/or minimum tillage areas** | There is insufficient excrement due to low poultry population | | | |
| **More eggs will hatch** | • 8 women's hens are not producing eggs<br>• 1 woman's hens are broody | • 1 woman has stopped using hen house<br>• 2 women's hens are not laying<br>• 1 woman does not have laying hens | • 1 woman's pigs broke into hen house and ate eggs<br>• 7 women's hens are laying<br>• 1 woman's hens are "changing clothes" | • 9 women's hens are laying eggs |
| **Count the number of eggs consumed by family, sold or given away** | All eggs used for family consumption (numbers not recorded) | | | Used for consumption or hatching (numbers not recorded) |
| **During the rains, there will be no *chak pech* (skin parasite)** | Rainy season does not occur during this period therefore unable to monitor | | | |
| **We will eat eggs and meat** | Too soon to monitor changes | | | |

## Analysis: "Things to try"

In Mahas, X'culoc and Sahcabchen the principal monitoring method was to put their list of "Things to Try" on a nearby wall during the monthly meeting and go through them one by one. One example of how this worked can be observed from a summary of a meeting in Mahas a month after they defined their list of things to try (see table 30). Three of the women commented that they learnt how to make the drinking bottles, but they are not using them as currently water is abundant (rainy season) and there is no need for them to actually give their birds water. Five of them had planted the Mucuna seedlings and were now waiting for them to grow. All of them had used lemon juice in their poultry's drinking water, but with different experiences depending on the severity of the cold symptoms. No one had cleaned out hen houses due to rains making such a task very difficult and no one had de-wormed. Two participants tried out commercial brands of cold remedies for humans (Vapour rub and Mejoral) on their birds.

Interestingly, the prioritisation of "Things to Try" the researcher's sought had naturally occurred. It was the rainy season and cold remedies were of greatest importance. Furthermore, lemon is available free to them in their home-gardens and its "application" takes up very little time. The time and rains issues were also raised when the women commented that improved hen-house management is problematic during the rains as pigs seek refuge in the hen-house, and this generates a great deal of mud. Another women lost 13 chicks because they drowned in the rains. She said she did not have enough time to put them in before the rains poured down.

## Monitoring experiments via discussions

Using lists written in bright primary colours proved to be an important technique. But, given the potential problems surrounding testing new husbandry techniques, the researchers also spent large parts of each monthly meeting discussing problems related to their experiments, and this led to new actions being taken. In Xohuayan for example, despite the restoration of egg production (see table 28), many of the women despaired of the hen house and abandoned its full-time usage. The researcher's urged a revision of the group's objectives in an attempt to "evaluate" their experience to date. The women expressed a need to meet alone without the researchers to discuss their future. The researcher's readily agreed and one month later returned to hear the results of their meeting without the researchers. They had met as agreed, but instead of evaluating themselves or analysing their future, they had decided to use their meeting to prepare and try out de-worming with a herbal treatment the researchers had shown

them. A discussion arose, about the types of problems they were currently having with their poultry. From this the researchers drew out a subject list (see box 3) that served as the basis for their future experiments, and were to be monitored along with the hen-house innovation.

**Box 3. Things to try**

- Local/cheap cold treatments
- Different treatments for different types of diarrhoea
- Easy control methods for contagious diseases
- Apply foul-pox vaccinations

These activities were discussed, debated and some tested out during the eight months. The vaccination option was discarded after a lengthy debate between the CE group and researchers about the risks of applying the vaccination to weak poultry. However, the women pursued the other activities.

## Visiting Sites of Experiments

In all four villages this simple process of visiting the experiments of other campesinos in their own village and others was key to CE group meetings.

- In Sahcabchen, this involved all the campesinos helping-out to catch and weigh the pigs. At times, this proved impossible because they couldn't catch the pigs, or they did not want to weigh them as they thought they were too thin.
- In X'culoc, visits were made to the home gardens where experiments had been planned. Frequently this proved to be a sobering experience, as they had not carried out what they planned to, or their experiment had not worked e.g. Mucuna in home garden died.
- In Xohuayan, the women went to visit their colleagues' hen houses on a regular basis. This offered good opportunities to discuss husbandry techniques. In all villages, it assisted in allowing campesinos to share ideas and experiments.
- In Mahas, a woman commented that she had fed her chicks whole maize grains since three days old and they were growing fine. This diet had saved her time and money that would have been spent milling maize. However, other women said feeding whole maize grains to chicks had not worked for them and their chicks had died. A rich and enthusiastic discussion ensued amongst the women about variations in diets.

Several exchange visits to experiments in other villages were organised by the researchers and NGOs. This was considered important for the researchers as one village in particular, Xohuayan, had been cultivating Mucuna for several years and had a successful pig-rearing experience based on alternative feeding strategies.

These types of visits facilitated reflection upon the constraints and opportunities available to campesinos in the different villages. Market access, soil types, local vegetation for forages, and seed varieties were key themes discussed and compared by the campesinos. However, these topics were sometimes considered negative as many campesinos reflected upon the lack of resources in their village when compared to others. Although, they did serve to stimulate experiments in their own villages as the campesinos expressed desire to carry out innovations in animal husbandry techniques.

## 4.3 ANIMAL HEALTH WORKSHOPS

***Techniques: village maps to identify disease transmission, illness calendars, drawing illness, problem-opportunity tree analysis, seasonal feed calendars and brainstorming.***

Health issues did not fall explicitly within the research team's remit for collaboration nor form part of a PM&E agenda. However, in order to respond to the campesinos questions about animal health, an opportunity was sought to link the issues of health to problems with their diet and campesinos' experiments. Furthermore, the collaboration between the research project and the campesinos would have greater immediate benefits for the campesinos, given their genuine problems related to animal health. In each village, the research team offered a different "service".

- In Mahas, the team made monthly visits, during which a workshop environment was created and the main health problems, identified by the campesinos, dealt with.
- For Sahcabchen and X'culoc, animal health workshops were given in conjunction with the NGO, which also invited their "promotores" from other villages to assist in order to achieve greater diffusion.
- In Xohuayan, as part of the long-standing research collaboration, the women had already participated in pig health workshops. As part of the hen-house project, they received specific guidance on health problems related to housed-poultry (disease transmission, diarrhoea, clean feeding receptacles, and other prevention strategies).
- Animal health workshops were held in parallel with the CE groups meetings, and from the themes dealt with in the workshops, ideas for experiments were often generated.

### Village maps and illness calendars

In all villages, the workshops on poultry and pig health utilised participatory methods to assist in the shared learning experience. One small example of this can be observed in the following case. In Mahas, in one workshop session, the causes, effects and treatments of fowl-pox were discussed using visual aids. To consolidate the learning process the women

(24 in total) were divided into two groups. One group constructed a seasonal illness calendar, while the other drew a map of the village on which households with ill poultry were identified, as were locations where dead, and infected, animals were thrown. Each group then presented their findings to the whole group and discussions followed as to why seasons influence their poultry's health. The map allowed the researchers to re-emphasise how diseases are transmitted by other animals, a novel concept for these women. Furthermore, the application of these methods gave the research team valuable information on seasonal variations in Mahas and a detailed map of the village, which continues to serve as a reference point in meetings between researchers and the women's group. In addition, these resources proved useful to PM&E.

## Drawing illness

In the animal health workshops with the campesinos from Sahcabchen and Xculoc, the farmers drew pigs and identified where cystircercosis could be found. This was part of an important discussion on the causes of this illness and led to important local beliefs being expressed to the researchers. Several campesinos believed that cystercercosis was caused by eating a local plant and/or fruit. This type of belief could prove to be a severe limitation in testing out alternative locally available forages and plants. Hence, the health workshops also helped establish a common ground, based on trust and sharing knowledge that would enable testing of alternative animal husbandry strategies.

## Problem-opportunity tree analysis

Problem trees, as developed from Martinic's (1997) examples, enabled collaborative identification of problems, their causes and effects. They were carried out within group meetings to enable reflection about cause and effect, and opportunities available to campesinos to resolve animal health problems. A tree is drawn on a large sheet of paper, or sticks are used to create a tree. The trunk is the problem (e.g. high poultry mortality), the roots are the causes and the branches are the effects of the problem. The opportunity tree turns the situation around and the trunk becomes the desired situation (e.g. healthy chickens). The participants then think about ways in which this can be achieved by converting the causes of the problem into means to avoid illness. From this technique, experiments were also defined.

### Seasonal feed calendars

The animal health workshops were also used to reflect upon seasonal influences on poultry and pigs diet and the preparation of Mucuna and its use as a feed supplement. This was done via calendars (technique explained in chapter three), depicting monthly variations in feed availability.

Thus, the animal health workshops facilitated the identification of links between health and crop/livestock interactions. Furthermore, a wider context was presented within which experiments could be considered and evaluated.

## 4.4 CONCLUDING ANAYSIS AND EVALUATION

***Techniques used: Animal Inventory, Well-being ranking, CE Books and Consultative Evaluation (all explained in chapter three).***

### Regional Workshops

Until this point, the focus has been on the process of developing campesino experimenter groups and their experiments. Now the focus will turn to the results of the analysis and evaluation of the experiments which drew the process of PM&E to a conclusion. The results for the four villages are extensive. Hence, the results from one village, X'culoc, will be used as a specific example of the process and the results generated in the workshops, but generalised conclusions for all four villages will also be presented.

The objective of the first one-day regional workshop (June 1999) was to enable a participatory analysis of the tentative results, developed from well-being rankings and animal inventory (explained in chapter three). The all women groups were invited to participate in this workshop in order to scrutinise and criticise the analysis of the techniques undertaken by researchers. To facilitate this, the researchers divided the workshop participants into their EC groups and first discussed the technique of ranking and its objectives.

The results of wellbeing rankings in their villages were depicted with a hand-drawn piechart, showing percentiles and numbers of families belonging to each well-being stratum, with symbols of the assets that characterise each stratum. The piechart was entitled: "How We Live". The responses ranged from a despondent: 'yes, we really are that poor', to: 'no, there is one person who's poorer than all the rest', and in one village, the diagram was rearranged. Each group then presented their ranking results, with their own comments and changes back

to the entire group. Their insights and changes were incorporated into the ranking results for two of the villages. These are presented in Table 33.

It should be noted that the wellbeing characteristics and numbers of households belonging to each stratum were confirmed by the participants from all four villages. However, they repeatedly stressed that these results were only valid for that time-period as households may move from one stratum to another, depending on three key factors that change over time:

- harvest yields
- households' age
- illness.

**Table 33. Well-being results for X'culoc**

| HOW WE LIVE IN X'CULOC | | |
|---|---|---|
| **Strata** | **Number of Households** | **Key characteristics** |
| Very poorest | Not identified | • Purchase maize since June 1999<br>• Children do not help out<br>• Elderly<br>• Few chickens and pigs |
| Poorest | 14 | • Widows<br>• Abandoned women<br>• Labourers all-year<br>• Medical expenses<br>• Buy maize<br>• Some pigs and chickens<br>• Thatched roof house. |
| Poor | 45 | • Labourers from August to Sept<br>• Buy maize in this period.<br>• Poultry, pigs, bee-hives<br>• Thatched roof house<br>• Spend their maize harvest in advance<br>• Embroider<br>• Small children<br>• Borrow money to pay for medicine<br>• Children frequently ill. |
| Better-off | 12 | • Maize all-year round<br>• Poultry, pigs, bee-hives<br>• Stone house<br>• Shop and truck. |
| Well-off | 5 | • Hire-in labourers<br>• Maize all-year<br>• Poultry, pigs, bee-hives<br>• Stone house<br>• Shop, truck and steers. |

In the afternoon, the analysis of the animal inventories was presented to each CE group by facilitators, using a fictional character and discussing her animal husbandry according to season. The villagers then discussed whether this was a true case from their village, the nature of her difficulties and how she could improve her animal husbandry.

The following is an example of how the X'culoc animal inventory results were presented and discussed:

> *This is the story of don Licho and doña Casimira (fictional names). In this village, it rains from June to December and there is a drought from January to May. Don Licho harvests maize from October to March. His total harvest is 4,500 KG. He began to harvest squash in October until March. He sold the squash seed in the market town and gave his animals the fruit. Doña Casimira rears the pigs and*

*chickens. She feeds them with the maize and forage that don Licho brings from the milpa, but from June to September there is no maize in the milpa and they had to buy some and spent Mex. $1,800 on maize alone.*

The discussion that followed the telling of this "story" resulted in the generation of a list of strategies to overcome Licho and Casimira's problems:

- feed animals with squash
- use different forages
- plant Mucuna in milpa and in home garden
- Mucuna helps maize yield
- use Mucuna instead of maize to feed animals
- sell pigs.

The purpose of this workshop to the CE PM& E process was crucial for researchers. The joint analysis facilitated a reflection on the results and hence changes could be incorporated before the conclusions were drawn and presented in March 2000. The June workshop was particularly important for the animal inventory results as many of the limitations of the technique identified in chapter three were nullified, in particular the confusion over animal age-types.

The objective of the final one-day workshop in March 2000 was to facilitate a sharing of the experiences of each of the CE groups. It was also used to provide a forum whereby the campesino groups could think about how they wished to continue in the future. Approximately seventy campesinos attended and several local NGOs participated so that the future could be considered with potential NGO involvement. Each experimenter group informed the participants of the types of experiments they had tried, methods used and the benefits and problems experienced. They used mostly large sheets of paper with key words and images to explain their stories, told in Spanish and Maya. In addition, each group shared their books with the other groups. In Table 34, a summary is presented of the CE X'culoc groups' evaluation.

**Table 34. CE X'Culoc: Final Evaluation of Experiments and Look to the Future**

| PROBLEMS STARTING CE | ACHIEVEMENTS |
|---|---|
| • Sick animals<br>• Lack of knowledge about de-worming<br>• Excessive use of maize<br>• Lack of knowledge about alternative and important feeds for animal rearing.<br>• Lack of awareness about milpa production | • Pigs are now healthier<br>• Learnt and apply biological and conventional de-worming techniques<br>• Animals fatten quicker and sold<br>• Learnt about Mucuna as a forage and grain for pigs<br>• Learnt about other alternative feeds for animals<br>• Diminished amount of maize used for feeding animals<br>• Learnt a great deal about animal husbandry<br>• With what have learnt and are doing have a better opportunity to improve living standard<br>• Awareness about milpa production<br>• Mucuna planted in milpa<br>• Increased maize harvest<br>• Proved that where Mucuna is planted maize harvest improved<br>• Disseminated in village and in other villages what have learnt inCE |
| **CURRENT PROBLEMS** | **FUTURE ACTIONS** |
| • Unable to learn more about experiments due to lack of technical advice | • Keep trying out what have learnt with animals<br>• Spread what have learnt in our village and in other villages |

## Analysis in Villages

As one of the final presentations made by researchers to each CE group, prior to the March 2000 workshop, a summarised version of the animal inventory results was presented to the groups, in conjunction with the data on socio-economic status. Table 35 is an example of how that information was presented in the villages.

**Table 35. Chicken and turkey husbandry, compared by well-being status**

| | Nov | D | J | F | M | A | M | J | J | A | S | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CHICKEN** | | | | | | | | | | | | |
| Eaten | X<br>X | | X | | | | X | X | X<br>X | X | X<br>X | X<br>X |
| Die from illness | | | X | | | | | X | X | X | X<br>X | X |
| Hatch | | | | | X<br>X | X<br>X | X<br>X | X<br>X | X | | | |
| **TURKEY** | | | | | | | | | | | | |
| Eaten | | | X | | | | | | X | X | | |
| Die from illness | | | X | | | | X | X<br>X | X | | X<br>X | X<br>X |
| Hatch | | | X<br>X | | | | X<br>X | X<br>X | | | | |

X= families who are “not so poor” X = families who “live better”

## 6. RESULTS

In this chapter, we present the results of the following experiments: feeding mucuna seed to livestock, the animal inventory and the evaluation of the EC.

### Mucuna Seed Fed to Livestock

**Quantitative Analysis**

The Mucuna seed experiment was introduced to nineteen participants in two villages. Of the nineteen, only four experimented with it and fifteen did not experiment at all. Of those four, only three continued to use it. The significance level shows a strong tendency to not experiment, at $P>0.12$.

In terms of the two strata, there was little significant difference between experimentation levels ($P>0.288$).

**Qualitative Analysis**

Nine people were interviewed regarding the Mucuna seeds experiment. Two were from the poorest stratum, and seven from the poor stratum.

The primary benefits mentioned were the reduction in the use of maize, which was remarked upon by a member of the poorest stratum: “I give less maize now, and replace it with Mucuna. They grow quickly and fatten. I have already sold one which I fed Mucuna to for five months because it fattened so quickly”. In addition, over half of those interviewed stated that their livestock fatten more quickly, and almost all commented on their improved diets given that they have more appetite and receive more vitamins.

One woman stated that: “I compare my turkeys with my sisters turkeys. Hers do not eat Mucuna, only maize meal. Hers are smaller and the feathers do not shine as much as my turkeys' do. It helps because they grow well, and I do not have to buy food for them. The only problems now is that I do not have enough Mucuna now”.

In terms of work, almost all stated that it did not require a lot of work, although two stated that removal of the shell was time-consuming. Participants in one village in particular adapted the frequency of preparing the Mucuna as one woman mentioned: “Preparing the Mucuna every day would be a lot of work. I prepare large amounts every four days and it lasts me for the next time that I cook it”.

It appeared that the main problem experienced by participants was that they had insufficient seeds. Five of nine participants interviewed stated that they did not have sufficient seeds. Seeds were dedicated to sowing rather than feeding livestock. One lady stated that: “I do not sow Mucuna because my husband is not here (working outside of the village) and I am a woman, and do not know how to sow it”.

Two adverse effects of the experiment were described. One found that their pig initially had diarrhea, and the other one that their pigs became drowsy. Again, the reaction was that it was a ‘one-off’ problem. In addition, one participant commented that the resin left black stains.

## Mucuna Planted in the Homegarden

### Quantitative Analysis

The planting of Mucuna in the backyard was introduced to thirty of the participants, in three villages. Of the thirty, only nine experimented, and twenty-one did not experiment at all, with a significance level of $P>0.028$. Of the nine who experimented, eight have continued to plant Mucuna in their homegardens.

No pattern emerged according to the wellbeing level of experimenters or non-experimenters (significance level $P>0.426$).

### Qualitative Analysis

Five experimenters were interviewed, all from the poor stratum.

The main benefits were related to Mucuna as feed for livestock. They stated that pigs fattened quickly and that the consumption of maize was lower. As one participant said: It helps with maize consumption, because instead of the animals eating the maize, the family can eat it". The consensus was that the workload was "not much". The predominant problems were a lack of water (in both villages) due to the breaking down of the pump. One participant stated that the Mucuna grew too quickly, and two others that the chickens ate the seedlings.

One woman explained how she needed to have Mucuna planted in her homegarden so that it is accessible to feed to her chickens: "It is the first time this year that I am experimenting with this because last year my husband sowed it in the milpa and I never go to the milpa. My husband did not bring the Mucuna for me to feed my animals with, because he only sowed six plants. This year he has sown it in the homegarden so that it is closer and I can give it to my animals".

## Mucuna Leaf Fed to Livestock

### Quantitative Analysis

Mucuna forage was introduced to two of the four villages, amongst eighteen participants. Of the eighteen participants only 1/3 experimented and the remaining 2/3 did not experiment. There was a tendency towards non-experimentation ($P>0.157$). Of the six who experimented, only two are still using the experiment.

In terms of the different wellbeing groups there appeared to be little significant difference of experimentation.

### Qualitative Analysis

Four participants were interviewed, one from the poorest stratum and three from the poor stratum.

The main benefits cited are that livestock grow more quickly and that they look 'more beautiful' or healthier. In addition participants can sell them earlier than before and buy household needs. One of the poorest stated that they use less maize now.

The workload was not considered high. Interestingly, one participant adapted the experiment and sowed it in the homegarden rather than the milpa so that it was more accessible.

## Chicken Houses

***Quantitative Analysis***

Chicken houses were only introduced to ten participants in two villages. All ten participants experimented and they have continued to use the coops. The participants were from different wellbeing groups and there is no significant difference between level of adoption (invalid significance test).

It is interesting to note that the chicken houses were the only experiments in which financial incentives occurred, given that an NGO within the village donated the wire fencing.

**Qualitative Analysis**

Eight participants were interviewed; half were from the poorest stratum and half from the poor stratum.

The main benefits derived from the chicken houses were that, as mentioned by the poor stratum – they are healthier now (3/10). As one stated: "my chickens did not used to live – now I have fifty. They lay more eggs now, and we can kill the chickens for the Day of the Dead celebrations". Two stated that it is easier to collect the eggs now, and one stated that they do not eat their own eggs now. One participant mentioned that they do not eat seedlings, and that they do not enter the house and irritate the family. In addition, they mentioned that: "they can no longer sleep in the trees where bats used to bite them, and the chickens would often die". A few mentioned the financial support, which they had received from an NGO in order to purchase materials, as benefits of the chicken house.

The workload was commented to be "not much". Two mentioned that they have help from their family.

Some mentioned that at first they had to adjust to bringing food to the poultry: "When I enclosed my chickens I had problems because I had to bring dzilam (a type of forage), water, and squash. Before they used to scavenge it. My children help me". The problems seem to outweigh the changes, as she continues: "It is good because the fox does not eat them now. The chicken do not keep their eggs – one can collect them now".

A few different problems were remarked upon. Four mentioned that pigs or dogs had entered the chicken house. Two stated that poultry escaped. In the case of one chicken house, the roof fell in, so is being rebuilt. In terms of egg laying, two mentioned that chickens did not lay them at first, until they became used to the new surroundings; and another participant stated that those laid inside do not hatch. One woman found that the chickens and turkeys adapted: "In the first few days my poultry became ill, one died because it got its head caught in the wire meshing, they stopped laying eggs and they looked very sad. Now they lay eggs, and they are now happier in the chicken house than when they are outside".

Others have adapted management of the chicken house according to their circumstances for example: "I let them out once a day so that they can eat fruits and forage. I cannot bring forage to them in the chicken house and feed them myself because I do not go to the milpa". For another woman, whose husband is working outside of the village: "I have to buy forage to give to my chickens as my husband is not here to bring it. I also let them out to scavenge in the homegarden".

## Cold Remedies for Poultry

***Quantitative Analysis***

Lime and water, used as a cold remedy for chicken flu, was introduced in two villages. Of the twenty participants, nineteen experimented, and continued, and only one did not experiment. This was highly significant (P>0.000). No significant pattern emerged between the two groups. Therefore, it seemed to be equally accessible to both strata.

***Qualitative Analysis***

Three of the eight experimenters were interviewed. They were all from the poor stratum.

The benefits mentioned were that the remedy worked well, and that they had chickens rather than having to buy them. One woman explained: "I put five drops of lemon and water in the mouth of a chicken who had the flu. The next day it did not have the flu". The workload was considered minimal. As one woman stated: "It is not much work. You have to catch the chicken and put the remedy in its mouth. I use an orange tree leaf. Somebody helps me to put it in the chickens mouth". The experimenters experienced no problems. Adaptations of the remedy were made, for example, the use of honey rather than sugar.

## Vermiculture

***Quantitative Analysis***

Vermiculture was only introduced at the end of the project, to one village. Four of the eleven experimented, and seven did not experiment at all. Very little tendency was shown (P>0.366). Of the four, only two continued to use it. There was no significant difference of accessibility by the poor and the poorest.

***Qualitative Analysis***

Both of the experimenters were interviewed.

The main benefits cited were that eggs were laid daily by the chickens, which were fed on the worms: "The chicken, which is eating the worms, is fat and weighs a lot. It lays eggs daily. I am only giving the worms to one chicken so that I notice the difference between one which is eating the worms, and one which is not". In terms of the workload, it was considered "not much". As one lady stated: "when I am cooking I simply put the leftovers on the compost. I have not fed the worms yet to the chickens as I do not have enough worms yet, but I have added some of the compost to seedlings, which I am growing. My coriander plant grew very quickly". They had not experienced any problems.

Some were apparently put off the experiment given that: "they think that the worms may hurt them and bite their hands".

## Chicken Litter Used as Fertiliser

***Quantitative Analysis***

Chicken litter was introduced in two villages, to twenty participants. Of the twenty, fourteen did not experiment at all, and six experimented. There was a high tendency towards non-experimentation ($P > 0.074$). There was no significant difference between the two Strata.

It is interesting to note that five households tried the experiment once and then rejected it. Many of the women did not like collecting the litter and considered it 'dirty'.

***Qualitative Analysis***

Two participants were interviewed (one from S1, one S2).

The benefits stated were that the seedlings grew well with the excrement had been added to the soil. In terms of workload, both participants mentioned that they could only do it when they had the time. One had the problem of *mortandad* when many of her chickens were killed due to an unknown disease. Thus, there was very little excrement to collect

## Discussion

***Accessibility of Experiments***

The results show that the experiments were not 'exclusive' to any particular group. They were equally accessible to the poorest and the poor.

Collection of forage, poultry pens and cold remedies appeared to be the most accessible innovations, showing the highest experimentation rates. It is interesting to note that both forage and cold remedies were suggested by the campesinos rather than outsiders. There was 80-100 percent experimentation rate on these two experiments, and 30-40 percent for the other experiments. Poultry pens, which were initiated within the villages, should be treated separately given that an NGO donated the fencing.

It should be pointed out that the three innovations, which involved Mucuna were problematic, given the scarcity of the seeds and the high prices which campesinos could sell them for in 1999. This meant that many households sold them rather than feeding them to their pigs. In addition, there was little time to be able to produce enough.

Other analysis (which has not been discussed here so far) was conducted which revealed that there was no significant difference between other characteristics of the innovations in terms of accessibility and experimentation levels. Characteristics tested were:

- pig experiments vs chicken experiments
- crop/animal interactions vs non-crop/animal interactions
- innovations which involved both men and women vs those which involved only men or only women
- innovations with high material input vs innovations with low material input
- innovations with high time input vs innovations with low time input.

Thus, it appears that the main characteristic, which affected the level of experimentation was whether the experiment was locally suggested and 'demand-led'.

***Utility of Experiments***

Within the interviews, the open style of questioning allowed participants to define the benefits and problems. It is interesting to consider their criteria and how they assess the experiments.

For the poorest households, the **reduced use of maize** was considered an important benefit of feeding forage and Mucuna to livestock. It was recognised that the reduction of maize used for livestock increased maize availability for family consumption. This was particularly true of the poorest households who experience severe maize shortages.

The **speed** at which animals fatten was an important benefit raised for all feed alternatives. The **income** generated from sales was highlighted as being beneficial to the family for different purposes.

The increase in the **number of animals** was highlighted as an important benefit. In the case of the poultry pens, numbers of poultry reared increased. Both poultry pens and vermiculture appeared to increase the number of eggs laid.

Changes in the **aesthetics** of the animal appeared to be important. 'Pretty animals' was the term used to describe healthy animals. This was mentioned for all the alternative feed innovations, for both pigs and poultry.

The **workload** did not seem to be a constraint to experimentation for the majority of experiments.

Problems seemed to be specific to the experiments.

It is interesting to note that many of the benefits raised are visual observations such as the aesthetics, the rate that livestock fattened and the increase in numbers.

The speed of the impact of the benefits is important to the experimentation level. Those innovations for which tangible benefits were seen quickly such as cold remedies were experimented with widely – results were discussed within workshops and, participants, hearing positive results from other group members, attempted the experiments. The visual, quick, tangible benefits thus tend to be adopted and diffused more quickly. Those experiments for which benefits were delayed or over a long period (Mucuna experiments) had a lower experimentation level.

In conclusion, it has been seen that the experiments were accessible to all of the participants, and were appropriate to the different resource endowments of households. The criteria which participants used to evaluate the utility of the innovations are expanded upon further within the discussion of indicators in the strategy paper.

## 6.1 ANIMAL INVENTORY RESULTS

### Method

The method used to gather, process and evaluate the animal inventory information is presented chapter three. Here the results of descriptive and interpretative analyses of animal numbers by household and month, and maize allocation to animal feeding are presented and discussed.

### Results

The graphs and tables on the following pages show means plus standard deviations, or medians or percentages for the variables listed here:

- **Growing pigs:** monthly mean number kept per family for two adjacent wellbeing groups
- **Mature pigs:** monthly mean number kept per family for two adjacent wellbeing groups
- **Adult female turkeys:** mean number kept by households of two adjacent wellbeing groups
- **Mature turkeys:** monthly mean number kept per family of two adjacent wellbeing groups
- Monthly mean kilograms maize fed daily to home-garden livestock per family in two adjacent wellbeing groups
- Monthly median kilograms maize fed daily to home-garden livestock per family in two social adjacent wellbeing groups
- Monthly percentages of families feeding purchased maize to livestock for two adjacent wellbeing groups
- Types of livestock by function for poorest and poor families

**Figure 17. Monthly mean number of growing pigs kept per family for two adjacent wellbeing groups (F test 0.518, T test 0.00003)**

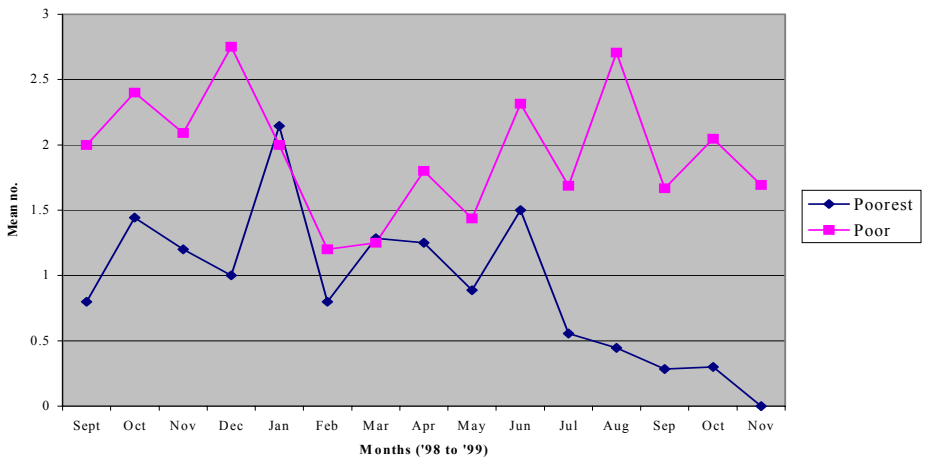


**Table 37. Data gathered of growing pigs kept per family for two adjacent wellbeing groups**

| | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mean Poorest** | 0.80 | 1.44 | 1.20 | 1.00 | 2.14 | 0.80 | 1.29 | 1.25 | 0.89 | 1.50 | 0.56 | 0.44 | 0.29 | 0.30 | 0.00 |
| **s.d.** | 0.92 | 1.51 | 1.08 | 1.34 | 1.51 | 1.14 | 1.11 | 1.39 | 1.36 | 1.50 | 0.85 | 0.70 | 0.46 | 0.65 | 0.00 |
| **Mean Poor** | 2.00 | 2.40 | 2.09 | 2.75 | 2.00 | 1.20 | 1.25 | 1.80 | 1.44 | 2.32 | 1.69 | 2.71 | 1.67 | 2.05 | 1.69 |
| **s.d.** | 1.10 | 1.88 | 1.93 | 2.21 | 1.91 | 1.61 | 1.48 | 2.18 | 1.46 | 2.16 | 1.74 | 2.69 | 1.88 | 2.13 | 2.06 |
| **F test** | 0.52 | | | | | | | | | | | | | | |
| **T test** | 0.00 | | | | | | | | | | | | | | |

**Figure 18. Mean number of mature pigs kept per family for two adjacent wellbeing groups (observations over four villages)**

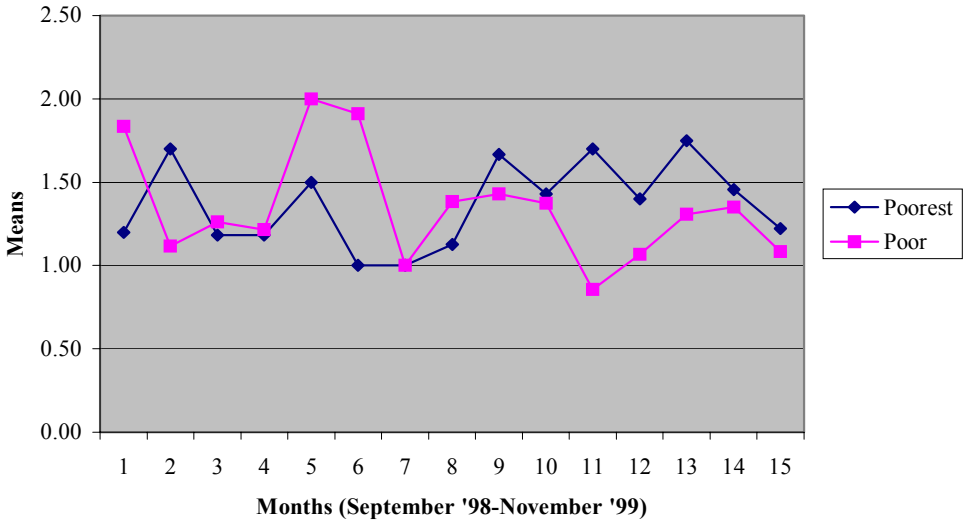


**Table 38. Data gathered of mature pigs kept per family for two adjacent wellbeing groups (observations over four villages)**

| | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mean Poorest** | 1.20 | 1.70 | 1.18 | 1.18 | 1.50 | 1.00 | 1.00 | 1.13 | 1.67 | 1.43 | 1.70 | 1.40 | 1.75 | 1.45 | 1.22 |
| **Sd** | 1.48 | 1.83 | 0.87 | 0.98 | 0.76 | 1.25 | 0.82 | 0.99 | 1.32 | 1.81 | 1.70 | 1.58 | 1.28 | 1.44 | 1.30 |
| **Mean Poor** | 1.83 | 1.12 | 1.26 | 1.21 | 2.00 | 1.91 | 1.00 | 1.38 | 1.43 | 1.38 | 0.86 | 1.07 | 1.31 | 1.35 | 1.08 |
| **Sd** | 0.98 | 0.86 | 0.81 | 0.58 | 1.13 | 1.76 | 0.78 | 1.19 | 1.09 | 0.81 | 0.86 | 1.03 | 0.85 | 0.99 | 1.08 |
| **F test** | 0.34 | | | | | | | | | | | | | | |
| **T test** | 0.43 | | | | | | | | | | | | | | |

**Figure 19. Monthly mean number of adult female turkeys kept by households of two adjacent wellbeing groups**

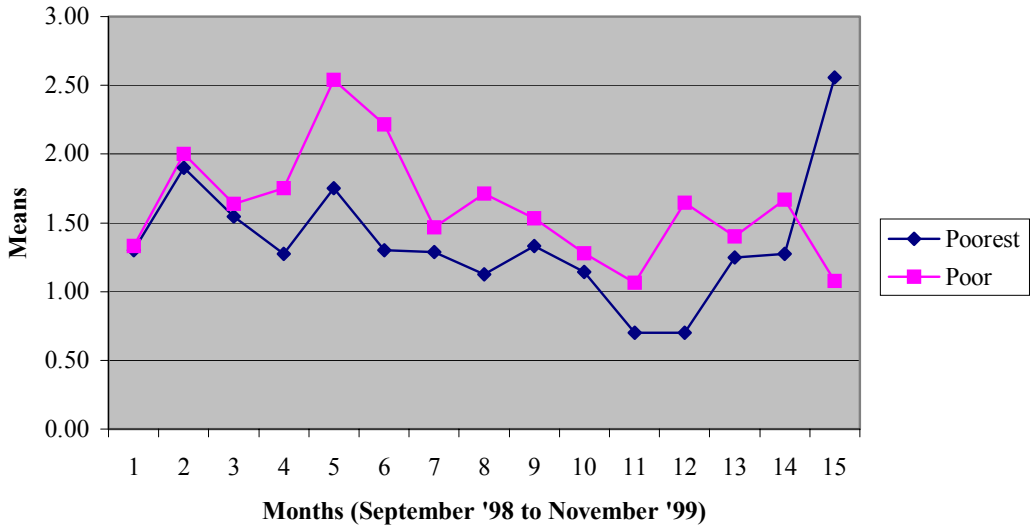



**Table 38. Data gathered of Adult female turkeys kept by households of two adjacent wellbeing groups**

| | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mean Poorest** | 1.30 | 1.90 | 1.55 | 1.27 | 1.75 | 1.30 | 1.29 | 1.13 | 1.33 | 1.14 | 0.70 | 0.70 | 1.25 | 1.27 | 2.56 |
| **s.d.** | 1.57 | 2.56 | 2.77 | 2.00 | 2.49 | 1.57 | 1.38 | 1.46 | 1.12 | 1.46 | 1.06 | 1.06 | 1.28 | 1.19 | 3.68 |
| **Mean Poor** | 1.33 | 2.00 | 1.64 | 1.75 | 2.54 | 2.21 | 1.47 | 1.71 | 1.53 | 1.28 | 1.06 | 1.65 | 1.40 | 1.67 | 1.08 |
| **s.d.** | 1.03 | 1.45 | 1.94 | 1.61 | 2.47 | 2.22 | 1.45 | 1.24 | 1.31 | 1.36 | 1.18 | 1.41 | 1.06 | 1.40 | 1.26 |
| **F Test** | 0.63 | | | | | | | | | | | | | | |
| **T Test** | 0.050 | | | | | | | | | | | | | | |

**Figure 20. Monthly mean number of mature turkeys kept per family of two adjacent wellbeing groups**

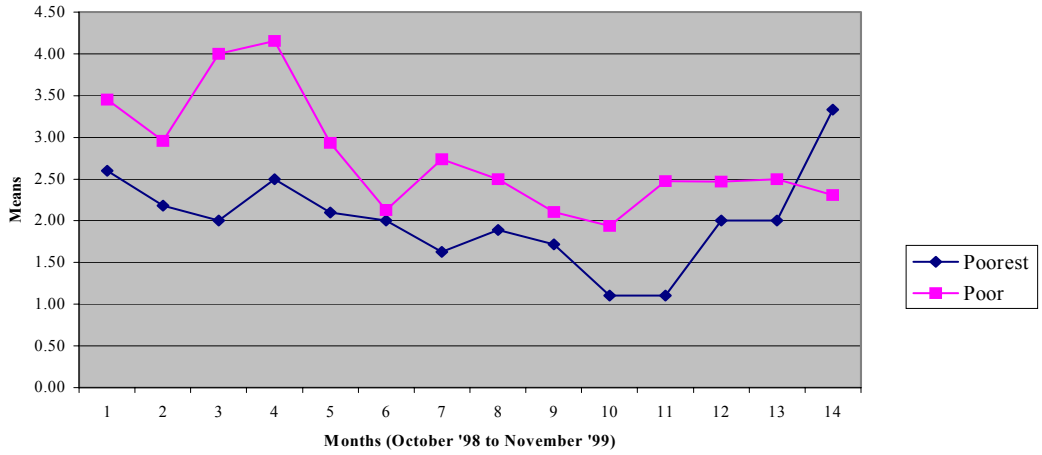
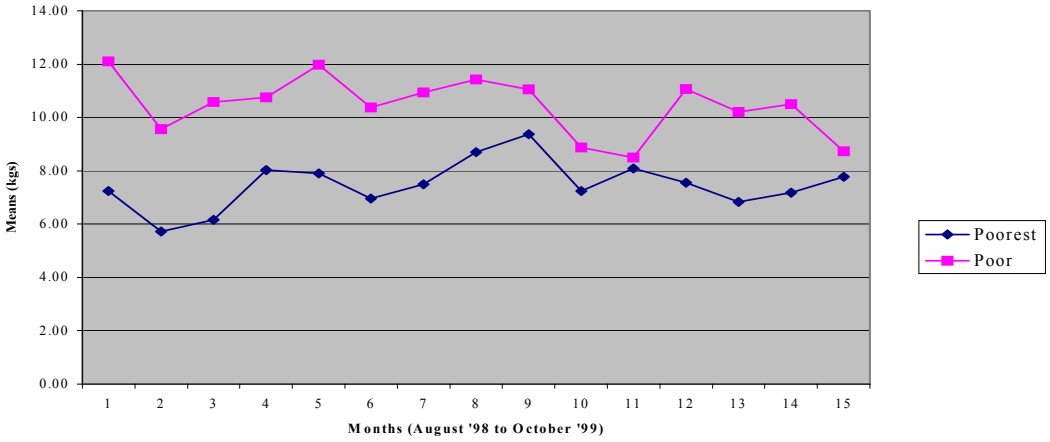



**Table 39. Data gathered of mature turkeys kept per family of two adjacent wellbeing groups**

| | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mean Pooerst** | 2.60 | 2.18 | 2.00 | 2.50 | 2.10 | 2.00 | 1.63 | 1.89 | 1.71 | 1.10 | 1.10 | 2.00 | 2.00 | 3.33 |
| **s.d.** | 3.47 | 3.71 | 3.10 | 3.46 | 2.38 | 2.38 | 2.45 | 1.45 | 1.70 | 1.29 | 1.29 | 1.51 | 1.55 | 4.58 |
| **Mean Poor** | 3.45 | 2.95 | 4.00 | 4.15 | 2.93 | 2.13 | 2.73 | 2.50 | 2.11 | 1.94 | 2.47 | 2.47 | 2.50 | 2.31 |
| **s.d.** | 2.56 | 2.70 | 5.56 | 3.36 | 3.13 | 2.06 | 2.34 | 3.20 | 2.85 | 2.35 | 2.58 | 2.36 | 2.32 | 2.39 |
| **F test** | 0.54 | | | | | | | | | | | | | |
| **T test** | 0.00 | | | | | | | | | | | | | |

**Figure 21. Monthly mean kgs maize fed daily to homegarden livestock per family in two adjacent wellbeing groups**



## 6.2 Evaluation

Here, eight different experiments are considered in more depth. They were selected according to their relevance to the original objectives of the project, and aim to reflect a cross-section of the experiments (feed alternatives, recycling of nutrients, animal health). Some of them were experimented in all villages, others in only one. The eight different experiments examined here are:

- forage collected and fed to livestock
- Mucuna seed fed to livestock
- Mucuna planted in the backyard
- Mucuna forage fed to livestock
- poultry pens
- cold remedies for poultry
- chicken litter used as fertiliser.
- vermiculture

**Objectives**

The evaluation was conducted to answer two main research themes:

1) how accessible were the experiments to the households? How many households were willing and able to experiment? Did this vary according to the wellbeing Stratum to which the household belonged?

2) what was the utility of the experiments to the households?

**Method of Analysis**

The results have been analysed both quantitatively and qualitatively by experiment. Quantitative analysis was used to address how accessible the experiments were to households and qualitative analysis to determine the benefits that were derived.

Quantitative analysis was conducted using the SPSS statistics package, and analysing, for each experiment, the number of total participants who (1) experimented, and (2) did not experiment. The chi square analysis was then calculated in order to analyse the significance level. This was then conducted by disaggregating the data according to the two different wellbeing strata 'the poorest' and 'the poor'. This enabled researchers to assess the

accessibility of the experiments and as to whether accessibility was differentiated according to socio-economic strata.

Qualitative analysis was carried out by analysis of the evaluation interviews. They are considered in terms of the benefits, problems and changes to workload in line with the interview structure. These were assessed according to the wellbeing Stratum to which the household belonged in order to determine whether experiments benefited one of the wellbeing Stratum over another.

The limitations of the data were discussed earlier and should be considered within the understanding of the results.

Each of the experiments is considered in turn.

## Forage

**Quantitative Analysis**

Forage appears to be highly accessible to participants. Of the 39 participants, 23 experimented and eight did not. Of those who experimented, only one stopped using it during the project period. The significance level between those who experimented and those who did not is extremely high, at $P > 0.00$.

There was no differentiation between the different strata in terms of the accessibility of forage to the poorest or the poor Stratum ($P>0.692$).

***Qualitative Analysis***

Sixteen experimenters were interviewed, from both the poorest (7) and the poor (9) strata.

Many benefits of forage were commented on. The poorest category in particular referred to the reduction in maize-use within the household. "They eat forage now – they become full and eat less maize. It helps with maize consumption because they eat less maize which helps the family" (villager). Almost all (10/16) of those interviewed stated that their animals grow more quickly now. Three commented that animals have more fat on them now. Two remarked that they were better off financially, which helped them if there was an illness in the family or they had to buy goods for the household. One stated that: "I sell the pig, and I can invest the money in the house". The other explained how: "if there is an illness in the family, having pigs helps because I can sell one to pay for doctors expense".

The workload did not seem to have increased very much. The majority received help from other family members. One participant, whose husband has migrated to the USA to work, purchases forage rather than actually picking it herself. Another participant does not collect it from the milpa, but from the homegarden, as she cannot spend the time going to the milpa.

Few problems were mentioned and they were considered 'one-off' problems. In two cases *huaxin* caused pig hair to fall off, and on another occasion, it caused a pregnant sow to have a miscarriage. When asked as to how the problem was dealt with, the reply was that: "it only happened once".

## Consultative Evaluation

The consultative evaluation aimed to:

- evaluate the impact of the experiments as perceived by the families
- record and share campesino's experiences between the different CE groups, and beyond
- investigate the appropriateness of the technology.

The objectives were too wide for one technique: the problems and limitations of this method are already outlined in chapter three. However, the results are interesting and therefore worth sharing. They also contribute to the evaluation needs. Thirty-five campesinos were interviewed. Their experiences with the experiments in numerical terms are summerised in table 36.

**Table 36. Campesinos involvement in experiments**

| Village | Number of Participants interviewed | Number of types of experiments | Number of experiments tried |
|---|---|---|---|
| Xohuayan | 9 | 5 | 21 |
| X'culoc | 9 | 6 | 21 |
| Sahcabchen | 8 | 6 | 21 |
| Mahas | 9 | 11 | 18 |
| Total | 35 | 14 (Several experiments were similar) | 81 |

The most common types of experiments were (in terms of total of campesinos undertaking experiments):

- forage for animals (19)
- feeding Mucuna bean to animals (10)
- feeding Mucuna forage to animals (10)
- plant Mucuna in milpa/arable (10)
- hen houses (10)
- Mucuna planted in home garden (5).

Other experiments were related to different remedies for poultry and pig illnesses.

## 4.4 CONCLUSIONS

The aforementioned analyses and evaluations contribute answers to the key questions raised in the socio-economic literature review related to how livestock projects have failed to improve rural livelihoods. They were:

- how does the socio-economic strata of households affect their ability to try experiments? How does this vary according to the experiment? Are there patterns between the resource

endowment of the household and the resource requirements of the innovation? If this is the case, what is the household: technology 'resource-fit'?

- are the benefits derived from the experiments, affected by their socio-economic stratum? If so, how? Are the benefits of the technologies 'captured by the few', i.e. the wealthier (Carney, 1997)?

Table 37 is a response to these key questions, considering Mucuna experiments undertaken by the CE groups.

**Table 37. Mucuna-Livestock Experiments Influenced by Poverty**

| Poverty & livestock | Poverty and experiments? | Technology "resource-fit' |
|---|---|---|
| Poorest do own livestock but they are badly fed, and/or not looked after properly because the poorest are too old or work as labourers and hence have no time. | Limitations:<br>• Lack of time<br>• Not enough money to work land<br>• Some have no land<br>• Too old or ill to try experiments | • Mucuna is an alternative for the poor who have less maize as it provides fodder and feed alternatives.<br>• Mucuna improves soil fertility and crop yields.<br>• Mucuna requires extra planting time |

A short summary is considered useful to conclude with as it presents us with an overview of the CE groups' process, in each of the villages. In Mahas, the use of participatory methods facilitated identification and analysis of issues that influence animal husbandry and stimulated the formation of a female CE group. In Xohuayan, a long-standing participatory research collaboration with an all-male campesino experimenter group gave access to some women interested in forming a CE group. In X'culoc and Sahcabchen, an existing participatory diagnostic process established by a development NGO was used as the basis for the initiation and facilitation process for CE groups. The project's PM&E process finished with a series of workshops that served to draw together the members of the various CE groups to share their experiences and results. It is hoped that this common research approach, applied in four villages, has produced interesting experiences to compare and contrast. In addition, that it may serve as an example of PM&E mechanisms and best practices with campesino experimenter groups, that others may develop.

# 7. SYNTHESIS

## 7.1 INTRODUCTION

This chapter focuses upon how livestock can improve the wellbeing of poor livestock keepers. The literature review demonstrated that many projects in the past have failed to reach intended project beneficiaries for a number of reasons including:

- many technologies which have been developed have been inappropriate to poor livestock keepers;
- wealthier farmers have often captured the benefits,
- poor delivery has occurred which meant that projects have failed to achieve their aims, or local organisations were unable to deliver services after the project (LID, 1997).

Experience of livestock development suggests that many policies and projects have been based on false assumptions about livestock-keepers aims and decision-making (Waters-Bayer and Bayer, 1992). Thus, the decision-making rationale, and objectives of livestock keepers needs to be further understood in order to develop appropriate interventions.

Households generally have multiple objectives and pursue a number of different activities in order to achieve them. Livestock rearing is one of these activities and involves a complex interaction of household resources, which are embedded in the decision-making process. Livestock may perform different functions for farmers such as food, a means to generate income, draught power, a buffer during uncertain periods etc. Other resources, and inputs, also have multiple uses such as maize, which may be used for human consumption or productive use such as animal feed. Thus, the allocations of scarce resources to different activities can involve trade-offs between one activity and another.

Households generally have different asset endowments, which affect their objectives and decision-making. During the critical hunger period in SE Mexico for example (July to September), households with different resource endowments respond in different ways. Poorer households struggle to maintain their immediate consumption and medium term productive activities, whereas those with more assets tend to have greater range of options and buffers to secure their livelihoods.

Information from different components of the project are presented here in order to improve our understanding of the objectives and decision-making rationale of livestock keepers in SE Mexico. First, wellbeing-ranking results are used to consider the role of livestock and crops for different wellbeing groups. Secondly, animal inventory results reveal decisions, which were made by livestock-keepers in their husbandry practices, the crucial role of maize, and the different functions which livestock perform. Results are then assimilated and discussed in order to gain a greater understanding of the role of livestock, and how the functions of livestock keeping can be enhanced, considering the constraints and opportunities for innovations.

### Wellbeing Results

It has already been seen that wellbeing levels vary in the study area. Here, results of wellbeing ranking are reiterated with a focus on livestock ownership. Seasonal elements are highlighted.

The poorest households produce insufficient maize for subsistence. Many have to work as labourers all year in order to generate income to meet immediate consumption needs. As one

villager stated: "They always have to go out to work, live on a daily basis, and work as labourers in order to buy maize. They do plant maize, but mostly they only can only carry out the first planting and this is risky as they may lose their harvest, or not harvest enough to last the whole year". In terms of livestock ownership, they all own poultry and at least half own pigs. They have very little buffer during difficult periods – as one villager stated: "they only look for what to eat today" (villager in Xohuayan).

The poor do not produce sufficient quantities of maize to support family needs throughout the year, but produce more than the poorest. They have to hire-out their labour during critical times of the year, generally from June to September, in order to earn money to be able to purchase maize and other household goods. All of the poor own both poultry and pigs, and generally have more than the poorest. Some have steers, which they have purchased on credit from government initiatives.

The most notable difference between the not so poor and the poor is that they are self-sufficient in maize. They have a variety of assets and pursue different livelihood activities. As one villager stated: "they do not have to work as labourers: they have a diversity of resources from which they can draw from in order to have enough to get through the year. For example, bees, a small-shop, a small truck" (woman from X'culoc). They have more resistance to shocks, and "do not run out of money during the year" (woman from Sahcabchen).

The well-off are self-sufficient in maize. They hire-in labourers to work on their milpa. In one village, they were described as: "those who have money all the time. Apart from having steers, milpa, arable, lots of pigs, and poultry they also have children who send them money on a regular basis" (woman from Sahcabchen). They have many buffers to protect them against vulnerable periods.

**Table 40. Characteristics of the different wellbeing groups**

| | **Poorest** | **Poor** | **Not so poor** | **Well off** |
|---|---|---|---|---|
| **Household demographic characteristics** | Elderly couples, newly weds, families with many young children | | | |
| **Maize Production** | Produce insufficient maize | Insufficient maize to last all year consumption needs | Self-sufficient in maize | Self-sufficient in maize (and sell) |
| **Labour Profile** | Work as day labourers | Work seasonally | Do not have to work as labourers | Hire-in labourers |
| **Livestock Assets Owned** | Own few chickens, some have pigs | Own pigs. Poultry, some have steers on credit | Own many pigs, poultry, steers on credit or purchased | Own many pigs, poultry, steers |
| **Other Activities/Assets** | | | Pursue different activities such as beekeeping, have small shop | Pursue different activities such as beekeeping, permanent salaried job, own shop, truck |

Understanding seasonal changes is critical for understanding the vulnerability of poorer households who are most affected by the critical hunger period. If maize and cash resources run out, there is the need to look for work on other farms in the village or elsewhere. This leads to a lack of input to their own field and reduced harvests for the following year (dependent on other labour resources in the household). The calendar below shows the seasonal aspects of wellbeing: when the hunger periods are experienced, and employment is sought by different wellbeing groups

Table ? Calender showing seasonal aspects of wellbeing

| **Months** | **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** | **S** | **O** | **N** | **D** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Weather** | ☼ | ☼ | ☼ | ☼ | ☼ | 🌦 | 🌧 | 🌧 | 🌧 | 🌧 | 🌦 | ☼ |
| **Traditional Milpa** | Cut down | Cut down | Burn | Burn | Plant | Plant | Plant | | | Harvest | Harvest | |
| **Hungry Period** | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| **Labour Hire** | HI | HI | HI | | | | | | | HI | HI | |

**Poorest**
**Poor**
**Well off**
**HI = Hire - in**

**Livestock Inventory Results**

Livestock comprise one of the assets, which make up households' asset portfolios. As was seen in the literature review, different assets may have multiple functions. Livestock can perform a variety of different functions from, for example, a form of savings to substituting household labour. Different households may have different, and multiple objectives, and use livestock for different purposes to meet these objectives.

Here we consider the different wellbeing strata - 'the poorest' and 'the poor', as defined from wellbeing ranking exercises with people from the villages. The animal inventory results presented previously and the wellbeing results are used to consider the roles of livestock for different wellbeing groups. First, we explore the sales, consumption and purchases of different livestock and then discuss the different functions, which they provide.

**Chickens**

Cockerels are referred to as 'the seed' in the region and it is important for households to keep at least one in order to enable reproduction and maintain productivity levels. Hens are kept by all families and only eaten when they no longer produce eggs. Female turkeys are prefered to hens for incubating eggs and rearing chicks.

*Consumption, Sales, Purchases*

Households from both wellbeing strata eat chickens though consumption levels are low. Hens are seldom eaten until March when they have finished incubating the eggs. There are notable differences between the poor and poorest consumption patterns. The poorest only eat them in April-May, and July-August. These periods are when there is little maize. They are therefore used as a buffer against food shortages during this time. The poorest eat very few livestock products, apart from hens and cockerels. In contrast, the poor eat chicken throughout the year, do not 'save' them for difficult periods and eat other livestock products.

Chicken is an important food during cultural events. At festivals such as Easter and Christmas, turkeys are traditionally eaten. However, those who cannot afford turkey, eat chicken instead. Chicken is the main food eaten at the Day of the Dead ceremonies in November. They are also used during family celebrations such as 15$^{th}$ Birthday parties.

Eggs are eaten when available and not required for reproduction. Eating them reduces losses that may incur when there are insufficient hens or turkeys to incubate them for hatching.

Sales are minimal. The poor sell chickens throughout the year. At the price of Mex. $15-25 per chicken, many of the poor have other assets of higher value, which they prefer to sell. They are sold when there are sufficient surpluses so as not to impinge upon stock levels. Sales are driven by occasional demand, rather than by the household's need for cash. As one villager stated: "there is no particular time of the year when we sell chickens – we sell them when somebody else from the village asks to buy one". However, the poorest only sell them in June during the critical period when a need for cash is high.

Few purchases of chickens take place. There is little demand and purchases range from 0-0.3 chickens per household per month, with little variation between strata.

*Functions*

For the poorest households therefore chicken production is a form of saving so that when resource shortages occur, they can be converted in to food or income to meet continuous consumption demands. Their low-cost, low risk and medium-productivity attributes make them one of the household assets best suited to fulfil such functions within the poorest households. For the poor households, chickens perform a productive function. They are reared for occasional sales and consumption throughout the year. Poor households tend to invest in assets with lower convertibility and more "lumpiness" than the poorest households.

*Chickens and Other Household Assets*

It is useful to look at the interaction of chicken production with other assets in the household. The rearing system places limited demands on cash, labour or land. The allocation of maize feed to chicken production is less than for other livestock and therefore there is less competition between maize used for chicken feed and other feed or human requirements.

*Chickens and Gender*

Chickens are a particularly important source of saving and production for women. They are one of the few household assets, which are owned and managed by women. Thus, they perform an important function in terms of providing an important economic role for women, which can be carried out in the home. This is likely to be increasingly important, given the current trend in male out-migration.

**Table 41 Different functions of chickens for the poorest and the poor households**

| Poorest | Poor |
|---|---|
| Buffer – form of saving that can be sold, eaten at difficult times<br>Consumption – during difficult periods<br>Sales – during difficult periods<br>Production – eggs , meat | Consumption – all year<br>Sales – few, all year<br>Production – eggs , meat |

**Turkeys**

Female turkeys are used to hatch all types of eggs. It is therefore important to keep them, at least, until eggs have hatched in April. Male turkeys are used for breeding and thus are important to maintain reproduction levels. They are also important in traditional ceremonies. The animal inventory results show that the main difference between wellbeing strata was in the number of male turkeys kept throughout the year. Female turkey numbers for poorest and poor households were similar.

*Consumption, Savings, Purchases*

Those in the poorest Stratum very rarely eat turkeys; only one instance of turkey consumption is recorded. It took place in October, when the household had harvested maize and were confident of the food availability for the following few months. The poor consume turkeys at different times throughout the year (recorded in January, April, August, September, October and November).

Turkeys are traditionally eaten during cultural events, in particular at Christmas and Easter. However, as discussed, the poorest tend to eat chickens rather than turkeys, chickens being more numerous in the poorest households and of a lower unit value.

The poorest sell more turkeys than the poor, and they sell them at an earlier age than the poor do. Sales occur throughout the year with peak periods in April-May, and July-August. During April to September, maize shortages occur, and turkeys are sold to buy maize. During the Easter period, there is demand for turkeys by the better off households in the village. Sales in July and August occur in order to generate income to buy maize in the most severe crisis period. The poorest households tend to sell their turkeys before they reach maturity on a 'needs-must' basis. The poor sell fewer turkeys, but in the same periods as the poorest due to their own maize shortages. Turkeys sales are often used by the poor as a means of purchasing livestock of higher unit value – they may sell a couple in order to invest in a piglet for example.

Only households from the poor stratum purchase medium or mature turkeys. Those from the poorest stratum rely on their own stocks.

*Functions*

For the poorest stratum, turkeys are very rarely eaten by the household but represent an important source of income. Turkeys can be sold for between Mex. $70-130, which is significant to many of the poorest. They are used as a buffer during the difficult times of the year when there are maize shortages. They are thus used as a convertible asset in particular during these times, and are one of the few productive assets that the poorest own. Their low cost, low input, low risk and medium productivity make them suitable to fulfil such a function for the poorest. The poor Stratum eat turkey more than the poorest, and do not sell them as

often. They play a predominantly productive role for the poor, although they are occasionally used as an income source.

*Turkeys and other Household Assets*

Turkey rearing is a low input activity requiring relatively little maize and labour.

*Turkeys and Gender*

Turkeys, together with chickens, are important assets for women given that they own and manage them, and can be managed within the home area.

**Table 42. Different functions of turkeys for the poorest and the poor households**

| Poorest | Poor |
|---|---|
| Buffer – form of insurance that can be sold, eaten at difficult times<br>Sales – during difficult periods, often immature turkeys<br>No consumption | Consumption – all year<br>Sales – few, all year |

**Pigs**

*Consumption, Purchases and Sales*

The poorest households only eat pigs when they are slaughtered for sale of meat.

Piglets are rarely purchased, but bred by the household. The poor purchase slightly more than the poorest do. Medium-sized pigs are very rarely purchased, and neither the poorest nor the poor stratum ever purchases mature pigs.

Pigs are generally used as a means to generate income. They can be sold at any point in their lives, and the decisions to sell are generally made based on the wellbeing of the household. The poorest stratum sells piglets and makes frequent sales from April to September, during the maize shortage period. In April, mean sales are as high as almost one piglet per household. The poor, in contrast, sell very few piglets.

The poorest also sell more medium-sized pigs than do the poor do. They sell them throughout the year, in particular during July and August.

The poor sell more mature pigs than the poorest. Mature pigs were sold only once in the year by the poorest stratum in July. The poor stratum sells them throughout the year. Similar numbers of mature pigs were kept by both strata. Yet, the higher sales by the poor stratum suggest that the poor have a higher turnover rate than the poorest households do (see the graphs presented in the results on animal inventory).

*Functions*

The poorest stratum uses pigs as a buffer in order to smooth consumption of maize etc. through the year, and to enable them to pay for expensive outgoings e.g. medical and school costs. The number of piglets reared increases from February and they are then sold from April in order to generate income during maize scarce periods. The poorest households also

sell more medium-sized pigs during this period. They do not have the capacity to maintain pigs until they reach maturity, often the need to meet short-term goals surpasses longer-term production aims, and pigs are sold before they reach maturity. Pigs are one of the main convertible assets held by the poorest households.

The poor rear pigs as a productive asset and generally rear females for use as breeding sows. Castrates are kept and these plus culled boars can fetch high prices. The poor do not sell many piglets, and few medium-sized pigs. They make decisions based on long-term production goals rather than short-term consumption needs. Savings are achieved with lower convertibility and higher productivity.

*Pigs and Maize Requirements*

Pigs are fed relatively large quantities of maize (see the graphs of maize use for livestock rearing in animal inventory results). Allocation of maize to feed pigs competes with the use of maize for human consumption. It enters the household decision-making rationale as a complex interaction with other assets. Trade-off decisions occur as to whether maize should be used as food or livestock feed.

As has been seen within the wellbeing analysis, maize production is pivotal to household wellbeing. It is a differentiating factor within communities, as summed up by one villager: "The village is not the same – there are some people who have more maize than others". It is a priority within the livelihood system. One villager was asked to rank five assets in the livelihood systems: maize, poultry, pigs embroidery and bees. Her response was:

*"Maize is the most important because without it we would have to buy it and we do not have the means to buy maize. Pigs are of secondary importance because when there is no money, they can be sold. Poultry are of third importance because it provides the family with food when none can be bought. Honey comes last and embroidery has very little importance but occasional sales are made."*

Two different types of maize are grown – creole and hybrid. Creole maize is grown in the milpa and can be stored for periods up to a year or more. Hybrid maize is cultivated in the labranza minima and mechanised areas, and cannot be stored. The poorest households have the capacity to cultivate less land and generally choose to produce hybrid maize for sale. Hence they do not produce as much creole maize therefore they cannot store maize and have to purchase it.

Pigs are sold through intermediaries or meat is sold by the households in rotation within the village. Maize is sold to CONASUPO, neighbours or exchanged for other food products in shops.

The percentages of households feeding purchased maize to livestock are shown in the graphs presented in the 'animal inventory results' section. The percentage of the poorest households that purchase maize ranges from 0 to 90 percent, with an average across the year of 30 to 40 percent. The poor households purchase maize in fewer months, with 50 percent purchasing maize in September, just before harvest.

It is important to explore in more depth the interaction between maize allocation and pig rearing. There are a number of different interactions:

*Storage of maize vs feeding it to pigs:*

- maize keeps its value better when it is fed to a pig, rather than stored. Conversion of maize fed to LWG of pig (approx 5:1). 5 kgs maize @ Mex. $1.20 = Mex. $6.00. 1 kg LWG = Mex. $15/Mex. $25 (grown pig)
- the risks involved with pig rearing is that they might die or be stolen, risks associated with maize (stored) are losses due to pests and storage problems
- pig prices are relatively stable across the year and tend to go up with inflation. Maize prices are low at harvest, and can increase up to 100 percent.

*'Saving maize' in pigs:*

- it can act as an enforced savings mechanism, given that pigs are less liquid and less accessible for use (sale or consumption) than maize.

*Sale of pigs at critical times – need for cash, and unable to maintain pigs:*

- if maize shortages occur, pigs represent assets, which can be sold to generate income, to smooth consumption
- households may not be able to maintain pigs during the maize shortage periods. The sale of pigs depletes household productive resources for the future. It also means that pigs are sold at a younger age and there is less revenue. This is particularly true for the poorest. Thereby there is a compounded need for cash and the poorest are unable to maintain them due to lack of maize.

.

It is interesting to note that villagers do not value their home-produced maize in the same way that they value purchased maize. They place a higher value on purchased maize and have commented on how when they do need to purchase it they give less to livestock. In some villages, maize is often used as currency.

It is interesting to explore a case when households have minimum maize resources, and the decisions, which are made within this period. Decisions, which affected the whole livelihood system rather than only livestock, are included so that maize and livestock can be considered within the household system. The sale of, often immature, livestock during crucial periods of the year is notable.

**Case Study of Maize Crisis**

A case study in one village, Xohuayan, shows the response of one household from the poor Stratum, to the exhaustion of maize supplies in April, following a very poor harvest the previous October. The household consists of a husband, a married couple and their five children who are all less than 15 years old:

*In April, the household ran out of maize, which they had harvested the previous October. They purchased 1100 kgs of maize (Mex. $2.4/kg). The husband worked for three weeks in a tourist resort in order to generate income (Mex. $1800) and in addition, a loan was received from the wife's father (Mex. $1000). Three piglets were sold (Mex. $215 on average per piglet) and Mucuna was sold for Mex. $1320. The government payment of Progresa (bi-monthly education grant for which payments are often late and at irregular intervals) was received by the family in the same month for Mex. $600. The village fiesta took place. It is customary to have new clothes for the fiesta and the wife sold hand-woven bags to a value of Mex. $425 to pay for new clothes.*

*In May, the family suffered further strains, as the wife became ill. The husband worked in two different towns for one week each, in order to pay medical bills of Mex. $225, and repay Mex. $150 towards the debt to the father. Building materials which had been bought previously had to be sold (Mex. $150). Three pigs were sold (Mex. $420).*

*In July the wife's illness worsened and medical bills amounted to Mex. $2385. A further five pigs were sold for Mex. $780, and another loan of Mex. $1000 from the husband's father was received in order to pay medical bills. Progresa of Mex. $600 was paid in this month. Government payments of PROCAMPO (annual payment for agricultural purchases) were paid and were dedicated to agricultural inputs – at least Mex. $1500 of the Mex. $2000 was allocated to hiring-in workers to carry out the felling of trees.*

*In August the mother recovered from her illness. Maize stores were sufficient for the household but a low quality maize was purchased (180 kgs @ Mex. $1.9) to feed the livestock. Progresa worth Mex. $600 was received again.*

*In September, a further Mex. $270 was spent on 150 kgs of maize. The household paid Mex. $500 towards a bull, which they purchased on credit through a village association that they belong to. In addition, they purchased necessities for the children who were starting a new school year. They received a Progresa payment of Mex. $600, and sold some more handicraft for Mex. $85.*

*In October, they harvested a better maize yield. However, within the critical six months they had sold many of their pigs, had had to work outside of the village and neglect the milpa and become more indebted to relatives. It will take at least a few months to return to their previous wellbeing level.*

It can be seen within this example that 21 percent of income during the period was generated from livestock sales, 27 percent from government payments, 24 percent from wages, 22 percent borrowed and 6 percent from the sale of handicraft. In other case studies, the percentage of income generated from livestock sales was as high as 36 percent.

## ***Discussion and Conclusions***

### *The Importance of Livestock within the Household*

Households are vulnerable to uncertain events. Poorer households, who have smaller resource endowments, are more vulnerable to uncertainties. Livestock enter the decision-making rationale of poor households as an important asset with different functions. Not only do they have fewer animals but they also have less diversity. As we have seen they have poultry and pigs, whereas the well off own honeybees and steers. Therefore in difficult periods the well off have more options open to them and more strategies which they can pursue.

As we have seen households have a dual economic nature in that they are both a family and an enterprise. They make decisions based on both production and consumption goals, which distinguishes them from other farm enterprises (Ellis, 1988). The poorer the household, the more integrated production and consumption decisions are. The poorest produce so that they can smooth consumption. Chickens are eaten or sold during the maize-scarce periods. Turkeys are rarely eaten, but are an important asset to sell when maize shortages occur. Pigs are sold as piglets or growing pigs, and are often sold at the beginning of the maize shortage period. Turkeys and pigs are sold when they are immature rather than allowing them to

develop to maturity and generating more income. Poorer households tend to have to convert their productive assets into income or food earlier than other households.

For poor households livestock perform productive functions. Chickens are eaten and sold throughout the year. Turkeys are consumed during festivals, and maize scarce periods. They are often sold so that the income is allocated to the purchase of a more productive asset such as a piglet. Pigs are kept throughout the maize scarce period. If, for example, a growing pig is sold, piglets are purchased in order to replenish stocks. They are generally reared until they are mature therefore generating the higher revenue than the poorest. Assets are converted into cash or income when animals are mature, in order to meet production objectives rather to smooth consumption.

**Table 43. Livestock functions for poorest and poor households**

| **Livestock** | **Poorest households** | **Poor households** |
|---|---|---|
| **Chickens** | | |
| Chicks | Productive | Productive |
| Growing chicken | Convertible | Convertible |
| Hen | Productive/convertible | Productive/convertible |
| Cockerel | Productive | Productive |
| **Turkeys** | | |
| Hens | Convertible/ Productive | Productive/ Convertible |
| Stags | | |
| Pigs | | |
| Piglets | Convertible | Productive |
| Medium Pigs | Convertible | Productive |
| Mature Pigs | Productive/convertible | Productive/convertible? |

**Conclusion; Improvements in Wellbeing**

It is important to consider how livestock can be used to improve wellbeing. The analysis of the functions that they perform for different wellbeing strata has provided insights into the strategies and objectives which households pursue. We can infer that improvements in wellbeing from 'the poorest' to 'the poor' would lead to the following:

- animals sold at more mature stages
- declining relative importance of savings and convertible assets
- increasing integration of convertible asset functions with productive or consumption assets
- market value rather than maximisation of use value (see the socio-economic literature review)
- recognition of the important role that women play in livestock rearing

This discussion is continued, in a more general way, to look at indicators of the effects of livestock projects on wellbeing levels, in the strategies section that follows.

## REFERENCES


Alderman, H., Chiappori, P.A., Haddad, L., Hoddinott, J., Kanbur, R. (1995) Unitary vs Collective Models of the Household: Is it Time to Shift the Burden of Proof? *The World Bank Researcher*, Vol.10, No.1. Feb 1995 pp.1-19

Amartya, L and Loader, R (1999) Participatory Rural Appraisal: Extending the Research Methods Base. *Agricultural Systems* 62 (1999) pp.73-85

Anderson, A. (1990) Deforestation in Amazonia: dynamics, causes, alternatives. In: *Alternatives to deforestation: steps towards sustainable use of the Amazon Rain Forest*. (Ed. A.Anderson). New York: Colombia University Press.

Anderson, S., Drucker, A. G. and Clarke, S. (2000) Livelihoods and animal genetic resources: how can people's conservation contribute to poverty reduction? Keynote paper presented at the:*The local livestock breeds and sustainable rural livelihoods* Workshop, Sadri, Rajisthan, India, November 2000.

Anderson, S. and Ferraes, N. (1995) *Campesino Agroecosystems: summary of rural appraisal findings 1991-1994;* FMVZ-UADY working paper, Merida, Mexico.

Anderson S., Ferráes N., Gúndel S., Keane B. y Pound B. (Editores) (1997). Cultivos de cobertura y el componente animal. En: *Memorias del taller regional Latino-Americano sobre "Cultivos de cobertura: componentes de sistemas integrados"*, 3-6 de Febrero. FMVZ-UADY, México, pp. 117-122.

Anderson, S., Gündel, S. and Jimenez Orsonio, J. (1994) Modelo conceptual del manejo de los recursos naturales por la unidad productiva campesina en la zona henequenera de Yucatán, Mexico. Memorias del Congreso de Investigacion en Sistemas de Produccion Agropecuarios; October 1994, Toluca, Mexico.

Anderson, S., Gündel, S., Keane, B. and Pound, B. (1997) Memorias del Taller Regional Latino-Americano *Cultivos de Cobertura: componentes de sistemas integrados*. Facultad de medicina Veterinaria y Zootecnia, Universidad Autonoma de Yucatan, Merida, Mexico, February 3-6.

Anderson, S., Gundel, S., Pound, B. and Triomphe, B. (2001) *Cover crops in smallholder agriculture: lessons from Latin America*. London: ITDG Publishing.

Anderson, S., Keane, B., Moguel,J., and Trejo,W. (1998) *Food, Feed and Forage: Food Security and Innovations within Campesino Agriculture*. Technical Report No.1 Working Paper, Merida, Mexico.

Archer, D. and Cottingham, S. (June 1997) *Manual Base del Metodo REFLECT*. Alfabetizacion Freireana Regederada Mediante Tecnicas para Potenciar el Apoderamineto de la Comunidad. Alfabetizacion Comunitaria para la Accion. London: Actionaid.

Ashby, J.A. (1986) Methodology for the participation of farmers in the Design of On-Farm Trials. *Agricultural Administration* Vol. 22 pp.1-19Great Britain: Elsevier Applied Science Publishers Ltd.

Ashby, J., Beltran, J.A., Gracia, T., Guerrero, M., Quiros, C.A., Roa, J.I., Trujillo, C.A. and Escobar, F. (1993-1996) *Cartillas para Comites de Investigacion Agricola Locales*. CIAT. Proyecto IPRA, Colombia.

Bainbridge, T. (1999) Community-based Animal Health Care in Zambia. *Development in Practice*, Vol.9, No.3 pp337-346.

Bardhan, P.K. (ed.) (1989) *The Economic Theory of Agrarian Institutions*. Oxford: Clarendon Press.

Belmar, R. and Morris, T.R. (1994) Effects of raw and treated jack bean (*Canavalia ensiformis*) and of canavanine on the short term feed intake of chicks and pigs. *J. Agric. Sci*. Camb., Vol.123, pp.407-414.

Bilinsky, P. and Gaylord, M. (1992) Outreach Pilot Project: Small Ruminant Research and Extension in Java. In *Plants, Animals and People: Agropastoral systems Research*. C. McCorkle (ed.). Boulder, Colorado: Westview Press.

Binswanger, H.P. and Rosenzweig, M.R. (1989) Behavioral and material determinants of production relations in agriculture. *Journal of Development Studies*, Vol.22, pp.501-539**.**

Birner,R. (1999) *The Role of Agriculture in Agricultural Development : Theoretical Approaches and Their Application in the Case of Sri Lanka*. USA: Aldershot.

Borget, M. (1992) Food Legumes. The Tropical Agriculturalist, CTA, London: Macmillan.

Budavari S. (1989). *Merck Index: An encyclopedia of chemicals, drugs and biologicals*. 11 ed. pp. 861-862.

Bunch, R. (1985) *Two Ears of Corn: a guide to people-centred agricultural improvement*. Lanham MD20801 University Press of America.

Bunch, R. and Lopez, G. (1995) *Soil recuperation in Central America: Sustaining innovation after intervention.* IIED Gatekeeper Series No.55. London: IIED.

Carew L. B. and Alster F. A. Gernat A. G. (1998). Blood Chemestry including Cholesterol, glucose and thyroid hormones of broilers fed raw velvet beans (Mucuna pruriens). Presented at the regional Animal Sciences Meetings-University of Massachusetts, June.

Carney, D (ed.) (1995) *Sustainable rural livelihoods: what difference can we make?* Department for International Development (UK).

Carter, S. (1993) Some Observations on Wealth Ranking after an RRA Looking at Soil Fertility Management in Northeastern Zimbabwe. *RRA Notes* No.19, pp 47-53.

Chambers, R. (1980) Rapid Rural Appraisal: Rationale and Repertoire. *IDS Discussion Paper* 155. Institute of Development Studies, Brighton.

Chambers, R. (1983) *Rural Development: Putting the Last First*. Harlow, England. Longmans.

Chambers, R. (1994) Participatory Rural Appraisal: Analysis of Experience. *World Development* Vol. 22 (9), 1253-1268.

Chambers, R., Pacey, A. and Thrupp, L.A. (eds.) (1991) *Farmer First. Farmer Innovation and Agricultural research.* London: IT Publications.Ciappe, M.B. (1994) Minnesota Farm Women and Sustainable Agriculture. In: *Indigenous Knowledge and Development Monitor*. Vol. 2(3) p.16 (Special Issue).

Chattopadhyay S. and Datta S. K. (1985). In situ and in vitro Pharmacognostic evaluation of Mucuna whith especial reference to L-Dopa contens and organogenesis in culture. *Acta Horticulturae* 188: 51-54.

CIEMSTAAT, Rabobank (1997) Sistemas Agroindustriales en Mexico: Indicadores, Situacion Actual , Tendencias

Connelly, T. (1992) Population pressure and changing agropastoral management strategies. In: C. McCorkle (ed) *Plants, Animals and People: Agropastoral Systems Research*. Boulder, Colarado: Westview Press.

Crawley (1998) bk
Dario Estrada, R. (1995) *Incidencia de las Políticas Economicas en la Conservacion de los Recursos Naturales de la Zona Andina*. REPAAN. CONDESAN.

Davis-Case, D. (1989) Community Forestry: Participatory Assessment, Monitoring and Evaluation. *Community Forestry Note 2.* Rome, Italy: FAO

Deaton, A. (1990) *Saving in Developing Countries: Theory and Review*. World Bank Economic Review, Special Issue: Proceedings of the World Bank Annual Conference on Development Economics, 1989.

Del Carmen, J. Gernat, A. G. Carew, L. B. (1998). Evaluation of velvet bean (Mucuna pruriens) as a feed ingredient for broilers. Presented at the Poultry Science Meetings-Penn State University, August.

Delgado, C. , Nicholson, C., Staal, S. (1997) Smallholder Dairying Under Transactions Costs in East Africa. *World Development*, Vol. 25, no.5, pp779-794.

DFID (1997) Livestock and Poverty: A Review of the Literature. Holden, S, Ashley, S. and Bazeley,P. (draft internal document).

DIFD (1999) Sustainable Livelihoods Guidance Sheets London: DFID.

D'Mello, J.P.F.and Devendra, C. (1995) (Eds.) *Tropical legumes in animal nutrition*. UK: CAB International.

D'Mello, J.P.F. and Walker, A.G. (1991) Detoxification of jack beans (Canavalia ensiformis): studies with young chicks. Anim.Feed Sci.&Tech. Vol. 33(1/2) pp117-127.

Dominguez X. A. (1973). *Métodos de Investigación Fitoquímica*. México: Limusa, pp. 42-43.

Dorward, A. (2000) Presentation at the "Livestock and Poverty" workshop, Wye College, June, 2000.

Dorward, A., Anderson, S. and Clark, S. (2001) Asset functions and livelihood strategies: a framework for pro-poor analysis, policy and practice. Contributed paper to Eur. Assoc. Agric. Econ. Seminar on "Livelihoods and rural poverty", September 2001.

Duke J.A., Reed C.F. and Weder J.K.P. (1981). Mucuna spp. In: *Handbook of Legumes of World Economic Importance* (Editor Duke J.A.. USA: Planum Press. pp. 170-173.

Duque A. D. (1993). Evaluación del Frijol Terciopelo (Stizolobium derringianum) en el control de Malezas en Cítricos y como Fuente de Proteína en la Ración de Pollos de Engorda. *Tesis Maestría en Ciencia Animal D.G.E.T.A., I.T.A.* No. 2. Conkal, Yuc.

Ellis, F. (1993) *Peasant Economics: Farm Households and Agrarian Development.* 2nd edn. Cambridge: Cambridge University Press.

Ellis, F (1998) Rural Non-Farm Employment, Logframe Output No.1(a), *Rural Livelihood Diversification : Framework and Categories*. (Unpublished).

Fafchamps, M., Udry, C. and Czukas, K. (1998) Drought and Saving in West Africa: Are Livestock a Buffer Stock? *Journal of Development Economics* Vol.55 pp 273-305.

FAO (1986) *Better utilization of crop residues and by-products in animal feeding: research guidelines. 2.A practical manual for research workers*. FAO Animal Production and Health Paper 50/2. FAO Rome 1986.

FAO (1995) *World agriculture: towards 2010. An FAO study*. N.Alexandratos (ed.). FAO and John Wiley.

Fernandez, M.E. (1992) The Social Organisation of Production in Community-Based Agropastoralism in the Andes. In C. McCorkle (ed.) *Plants, Animals and People: Agropastoral systems Research*. Oxford: Westview Express.

Freudenberger K and Freudenberger M (1994) Livelihoods, Livestock and Change: The Versatility and Richness of Historical Matrices. *RRA Notes,* No.20, April 1994 pp. 144-148

Fujisaka, S. (1994) Learning from six reasons why farmers do not adopt innovations intended to improve sustainability of upland agriculture. *Agricultural Systems,* Vol. 46, pp.409-425.

Goetz, S.J. (1993) Interlinked markets and the cash crop-food crop debate in land-abundant tropical agriculture. *Economic Development and Cultural Change*, Vol.41, No.2 (January 1993).

Gordon J. A. and Marquardt M. D. (1974). Factors affecting hemagglutination by concanavalin A and Soybean agglutinin. *Biochimical et Biophysica Acta* 332: 136-144.

Gosling, L. and. Edwards, M. (1995) *Toolkits: A Practical Guide to Assessment, Monitoring, Review and Evaluation.* London: Save the Children Fund.

Grandin, B.E. (1988) *Wealth Ranking in Smallholder Communities: A Field Manual*. Rugby, England: IT Publications.

Guendel, S. (1998) *Participatory Innovation Development and Diffusion: Adoption and adaptation of introduced legumes in the tradition al slash-and-burn peasant farming system in Yucatan, Mexico.* Magraf Verlag, Germany

Guerci, A. A. (1973). *Laboratorio: Métodos de análisis clinicos y su interpretación*. Argentina: Ed. El Ateneo, pp 81-82.

Hagerman, A. E. (1987) Radial diffusion method for phenolics. *Journal of Chemical Ecology* 13 : 437-449.

Haverjort, B., Vand der Kamp, J. and Waters-Bayer, A. (eds.) (1991) *Joining Farmers Experiments. Experiences in Participatory Technology Development*. Rugby, England: I T Publications.

Herbold Green (1998) bk.

Hess, C.G. (1997) *Hungry for Hope: On the cultural and communicative dimensions of development in highland Ecuador*. Rugby, England: I T Publications.

Holcombe, S. (1994) Productivity Profiles of Women Agricultural Producers. In: Sims Feldstein, H. Jiggins, J. (Eds) *Tools for the Field: Methodologies Handbook for Gender Analysis in Agriculture.* Rugby, England: IT Publications. pp.95-102.

Holden, S. J., Tanner, J. C., Dampha, K. and Jallow, A. (1992) Seeking innovation in the Gambia: An opportunistic approach to change. In P. W. Daniels, S. J. Holden, E. Lewin and S. Dadi (eds) *A Critical Review of the Delivery Services of Animal Health and Production Services to the Small-scale Farmer in the Developing World*, Yogyakarta, Indonesia: Indonesian Animal Science research and Development Foundation.

Humphreys L.R. (1995). Diversity and Productivity of Tropical Legumes. In: *Tropical Legumes in Animal Nutrition* (Editores D'Mello, J.P.F. and Devendra, C.). UK: Ed. CAB International, pp 1-21.

Hunt, D. (1991) Farm system and household economy as frameworks for prioritising and appraising technical research: A critical appraisal of current approaches. In A. Maswell and D. Hunt (eds.) *Rural Households in Emerging Societies: Technology and Change in Sub-Saharan Africa*. UK: Billing and Sons Ltd.

ICRAF (1993) *selección de areas y problemas prioritarios para la investigación agroforestal en la peninsular de Yucatán. Fase inicial de Diagnostico y Diseno. 19 al 28 de abril de 1993.* (Unpublished).

IFPRI (1998) Notes on DREAM2 – model for ex-ante evaluation of agricultural technology available online at: http://www.ifpri.org/dream.htm

INEGI (1991) Anuario Estadístico del Estado de Campeche.

INEGI (1991) Anuario Estadistico del Estado de Yucatán.

INEGI (1993) Yucatán: Síntesis de Resultados. XI Censo. General de Población u Vivienda.

INEGI (1995) Anuario Estadístico del Estado de Campeche.

INEGI (1995) Anuario Estadistico del Estado de Yucatán.

INEGI (1997) La Migracion en Mexico: Indicadores Estadísticos.

INEGI (1999) Anuario Estadístico del Estado de Campeche.

INEGI (1999) Anuario Estadistico del Estado de Yucatán.

INEGI (undated) Síntesis de Resultados de Yucatán 1960, 1970, 1980 (unpublished).

Jahnke, H.-E. (1982) *Livestock Production Systems and Livestock development in Tropical Africa*. Kiel: Wissenschaftsverlag Vauk.

de Janvry, A., Sadoulet, E., and De Anda, G. (1995) NAFTA and Mexico's Maize Producers. *World Development*, Vol.23, No.8.

Jiggins, J. (1986) Women and seasonality: Coping with crisis and calamity. *IDS Bulletin*, Vol.17 No.3. Institute of Development Studies, Sussex.

Kiff, L., Pound, B. and Holdsworth, R. (1996) *Cover crops: a review and database for field users.* Chatham, UK: Natural Resources Institute.

Kinsey, B., Burger K. and Gunnig, J.W. (1998) Coping with drought in Zimbabwe: Survey evidence on responses of rural households to risk. *World Development*, Vol.26, No.1 pp.89-110.

Knecht R and Chang J. (1986). Liquid cromatographic determination of amino acids after gas-phase hydrolysis and derivation with (dimethylamino) azobenzenesulfonyl Choride. *Analytical Chemistry* 58: 2375-2379.

Kotlikoff, L.J. and Spivak, A. (1981) The family as an incomplete annuities market. *Journal of Political Economy*, Vol. 89, No.2. April, 1981.

Kumar, K., (Ed.), 1993. *Rapid Rural Appraisal*. Washington: World Bank.

Kumar R. and D'Mello J.P.F. (1995). Anti/nutritional substances in forage legumes. In: Tropical Legumes in Animal Nutrition (Editores D'Mello, J.P.F. and Devendra, C.). UK: Ed. CAB International, pp 95-133.

Kurosaki, T 1995 Risk and insurance in a household economy: Role of livestock in mixed farming in Pakistan. *The Developing Economies,* XXXIII-4 December 1995.

León A.M.; Caffin, J.P.; Plassart, M. and Picard M.L. (1991). Effect of concanavalin A from jackbean seeds on short-term food intake regulation in chicks and laying hens. *Animal Feed Science and Technology* 32: 297-311.

Lightfoot, C. and Noble, R. (1993) A Participatory Experiment in Sustainable Agriculture. *Journal for Farming Systems.*

Livestock in Development (1997) The integration of livestock interventions into a sustainable rural livelihoods approach. In D. Carney (ed.) *Sustainable rural livelihoods: what difference can we make?* UK: Department for International Development.

Loker, W.M. (1994) Where's the beef?: incorporating cattle into sustaining agroforestry systems in the Amazon Basin. Agroforestry Systems Vol.25, pp.227-241.

Lorenzetti F. Maclsaac, S., Amason J.T, Awang D.V.C. and Buckles (1998). The phytochemistry, toxicology and food potential of velvetbean (Mucuna Adans. spp., Fabaceae). Fuente internet: http://www.idrc.ca/books/focus/852/06-sec05.html.

Martinic S. (1997) *Diseño y Evaluación de Proyectos Socials.* Herramientos para el aprendizaje. COMEXANI – CEJUV. Mexico.

McCorkle, C. M. (ed.) (1992) *Plants, Animals and People: Agropastoral Systems Research*. Boulder, Colarado: Westview Press.

McCorkle, C., Mathias, E. and Schillhorn, T.W. (1995) *Ethnoveterinary Research and Development*. Rugby, England: I T Publications.

McDonal P., Edwards R. A., Grenhalgh J. F. D. and Morgan C. A. (1995). *Animal Nutrition*. 5a ed. England: Logman Scientific & Technical, pp. 49-65.

McLeod M. N. (1974). Plant tannins- their role in forage quality. *Nutrition Abstracts and Reviews* 11: 804-815.

Mikkelsen, B. (1995) *Methods for Development Work and Research. A guide for Practicioners. London.* Sage Publications.

Narayan, D. (1996) Toward Participatory Research. *World Bank Technical Paper Number 307.*

Nimis, M. M. (1982) The contemporary role of women in lowland Maya livestock production. In *Maya Subsistence*, Academic Press pp313-325.

Noble, A. (1992) Women, men, goats and bureaucrats: the Samia women's dairy goat project. In C. McCorkle (ed) *Plants, Animals and People: Agropastoral Systems Research*. Boulder, Colarado: Westview Press.

OECD (199..) AD -wye.

Olaboro, G.; Okoto, M.W.; Mugerwa J.S. and Latshawa J.D. (1991) Growth-Depressing factors in velvet beans fed to broiler chicks. *East African Agricultural and Forestry Journal* 57: 103-110.

Papanek, H. (1990) `To each less than she needs, from each more than she can do', In I. Tinker (ed) *Persistent Inequalities – Women and World Development*, New York, Oxford: Oxford University Press. pp.162-181.

Parmesh Shah. (1990) Economic classification of a community using locally generated criteria. *RRA Notes* No.8 London: IIED.

Parr, W.H. (Compiler) and contributors, (1988). *The small-scale manufacture of compound animal feed.* Overseas Development Natural Resource Institute Bulletin No. 9. 64-70.

Peacock, C. (1996) *Improving Goat Production in the Tropics*. UK: Oxfam.

Pingali, P. L. and Rosegrant, M. (1995) Agricultural commercialization and diversification: Processes and policies. *Food Policy*, Vol.20, No.3, pp.171-185.

Poate, C. D. and Daplyn, P. F. (1993) *Data for Agrarian Development*. Cambridge: Cambridge University Press.

Pohl, M. and Feldman, L. (1982) The traditional role of women and animals in lowland Maya economy. In: *Maya Subsistence*, Academic Press, pp.295-314.

van der Poel A. F. B. (1989). Effects of processing on antinutritional factors (ANF) and nutritional value of legume seeds for non-ruminant feeding. In: *Recent advances of research in antinutritional factors in legume seeds*. (Editores: Huisman J., van der Poel T. F.B. and Liener I. E.). Netherlands: Pudoc Wageningen, pp. 213-229.

Pollak, R. A. (1985) A transaction cost approach to families and households. *Journal of Economic Literature*, Vol.7, pp 195-210.

PPDP (1999) Diagnostico Socioproductivo y Ambiental Para el Desarrollo Sostenible 1996-1999, (unpublished).

PPDP (1999) Informe del Avance Hacia el Desarrollo Sostenible en la Region de los Chenes (unpublished).

Pretty, J. (1989) Wealth-ranking in the Sudan. *RRA Notes*, No.7. London: IIED.

Pretty, J. Gujit I., Thompson J. and Scoones I. (1995). *A Trainers Guide for Participatory Learning and Actio.* London: International Institute for Environment and Development.

Price, M. L., Scoyoc, S. V., and Butler, L. G. (1978). Critical evaluation of the vanillin reaction as an assay for tannin in sorghum grain. *Journal of Agricultural and Food Chemistry* 26: 1214-1219.

Quijandria, B. (1981) Swine production systems in Central America. In A. J. Smith and R. G. Gunn (eds) *Intensive Animal Production in Developing Countries.* Occasional Publication 4, British Society of Animal Production, pp.279-289.

Rangnekar, S. D. (1993) Studies on the Knowledge of Rural Women Regarding Local Feed Resources and Feeding Systems Developed for Livestock. *Livestock Research for Rural Development.* Vol. 6 pp27-35.

Red de Experimentación Campesina Meeting, Veracruz, Mexico, 1998

Rehr, S. S., Janzen, D. H. & Feeny, P. P. (1973). L-Dopa in legume seeds: a chemical barrier to insect attack. *Science* 181: 81-82.

RRA Notes (May 1992) *Special Issue on Applications of Wealth Ranking.* Number 15. London: IIED.

Roeleveld, A.C.W. and Van Den Broek, A. (1996) *Focusing Livestock Systems Research*. The Netherlands: Royal Tropical Institute.

Rosenzweig, M. R. (1988) Risk, implicit contracts and the family in rural areas of low-income countries. *Economic Journal*, Vol.98, (December).

Rosenzweig, M.R. and Stark, O. (1989) Consumption smooting, migration and marriage: Evidence from rural India. *Journal of Political Economy*, Vol.97, No.4, (August).

RRA Notes (1994) No. 20. *Special Issue on Livestock*. London: IIED.

Ruiz, R. (1992) *Triumphs and Tragedy: A History of the Mexican People*. New York: W.W.Norton & Co.

Sansoucy, R. (1995) Livestock – a driving force for food security and sustainable development. *World Animal Review* Vol 84/85, No.3-4, pp. 5-17.

Sauerborn, R., Adams, A. and Hien, M. (1996) Household strategies to cope with the economic costs of illness. *Social Science Medicine*, No.3, pp.291-301.

Schuh., G.E. (2000) The household: The neglected link in research and programs for poverty alleviation. *Food Policy*, Vol. 25, pp.233-241.

Sen, A. K. (1984) *Resources, Values and Development*. Oxford: Basil Backwell.

Shah, P. (1995) Campesinos as analysts, facilitators and decision-makers. In: Nelson, N. and Wright, S. (Eds.) *Power and Participatory Development: Theory and Practice.* Rugby, London: IT Publications. pp.83-94.

Shapiro, H. (1991) *Assessment of Animal Agriculture in Africa: Economic Issues*. Addis Ababa: ILCA.

Sims Feldstein, H. and Jiggins, J. (eds.) (1994) *Tools for the Field: Methodologies Handbook for Gender Analysis in agriculture*. Rugby, England: IT Publications.

Sims Feldstein, H and Poats, S. (1994) A Gender-disaggregated Activity Calendar. In: Sims Feldstein, H. & Jiggins, J. (Eds.) (1994) *Tools for the Field: Methodologies Handbook for Gender Analysis in Agriculture.* Rugby, England: IT Publications. pp103-105.

Slocum, R.., Wichhart, L., Rocheleau, D. and Thomas-Slater, B. (Eds.) (1995) *Power, Process and Participation: Tools for Change.* Rugby, England: IT Publications.

Souza H. B. A. Souza P. A. Faleiros R. R. S. y Durigan J. F. (1991). Caracterizao fisica e avaliacao química e bioquimica de graos de Mucuna Ana (Stizolobium deeringianum). *Alimentos e Nutricao* 3: 29-38.

Staal, S., Delgado, C., and Nicholson, C. (1997) Smallholder dairying under transactions costs in East Africa. *World Development*, Vol.25, No.5, pp.779-794.

Steinfeld, H., de Haan, C. and Blackburn, H. (1997) *Livestock-Environment Interactions: Issues and Options.* A study sponsored by the EU, FAO, US AID and the World Bank.

Swallow, B.M., and Brokken, R.F. (1987) Cattle Marketing Policy in Lesotho. *African Livestock Policy Analysis Network* Paper 14. ILRI. Addis Ababa.

Temu, A.E., and Due, J.M. (2000) Participatory appraisal approaches versus sample survey data collection: A case of smallholder farmers wellbeing ranking in Njombe District, Tanzania. *Journal of African Economies*, Vol.9, No.1, pp.49-62.

Tulachan, P. M. and Neupane, A. (1999) *Livestock in Mixed Farming Systems of the Hindu Kush-Himalayas: Trends and Sustainability*. ICIMD and FAO. Rome: FAO.

Vaccaro, L. (1997) Constraints and opportunities for livestock development in mixed farming systems in tropical Latin America and the Caribbean. *Outlook on Agriculture*, Vol.26, No.4, pp.227-235.

L. van Veldhuizen A., Waters-Bayer R., Ramirez, D. A. Johnson and J. Thompson (eds.) (1997) *Farmers Research in Practice: Lessons from the field*, Rugby, England: Intermediate Technology Publications.

Vijayakumari K., Siddhuraju P. and Janardhanan K. (1996). Effect of different post-harvest treatments on antinutritional factors in seeds of the tribal pulse, *Mucuna pruriens* (L.) DC. *Journal of Food Science and Nutrition* 47: 263-272.

Von Keyserling, A. (1999) The use of donkeys in the Mexican central highlands: A gender perspective. *Development in Practice*, Vol.9, No.4, pp.437-448.

Walker, T.S. and Ryan, J. G. (1990) *Village and Household Economies in India's Semi-arid Tropics*. Baltimore, Md: John Hopkins University Press.

Waters Bayer, A. and Bayer, W. (1992) The Role of Livestock in the Rural Economy. *Nomadic Peoples*. Vol.31.

Waters-Bayer, A. and Bayer, W. (1994) *Planning with Pastoralists: PRA and more: a review of methods focused on Africa***.** Vol. 422. Eschborn: GTZ**.**

Wilde, V.L. (1998) *Socio-economic and Gender Analysis* (SEAGA) Field Handbook. FAO, Rome.

Wilson, R. T. (1995) *Livestock Production Systems.* The Tropical Agriculturalist, CTA. London: MacMillan.

WRI and GEA. (eds.) (1993) El Proceso de Evaluacion Rural Participativa: El Proceso de ERP Una Propuesta Metodologica . Institute of World Resources, New York.