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Production Systems and Livelihood Strategies in Southern Bolivia

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Abstract

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In the National Reserve Tariquía and its influence zone the Valle Central, traditional socio-economic activities of the rural population are centred on agriculture and transhumant cattleholding. Due to forage shortages, every year farmers from the Valle Central take their cattle to the Reserve to graze for six months on forest pastures. In Tariquía, where households are subsistence agriculturalists, transport of products to markets is limited due to lack of roads. In the Valle households are market-oriented, but mainly small-scale producers. The discussion on livelihood systems focuses on the problem that households, especially poor risk-prone ones, adhere to a portfolio of different activities to assure their survival. Hence the objective of this study is to assess the production systems and diversification of livelihood strategies and their influence on each other.

Data was collected from a randomly selected sample of households in two communities (inside and outside the Reserve) using quantitative and qualitative methods. A gross margin analysis was conducted. Applying statistical tests, a comparison was made between the differences of production performance and livelihood diversification.

Economic calculations reveal productivity and profitability rates of households outside the Reserve to be significantly higher than those inside. Additional performance indicators demonstrate similar results. Various livelihood indicators, specific to the area, were selected for the diversification on-farm, the livelihood strategies (activities others than agricultural ones) and migration. There was found to be a higher diversification of non-agricultural activities inside the Reserve, whereas on-farm diversification was higher outside. However, overall there was no significant difference to be observed in terms of diversification. Performance within their production systems was not related to pursuing a variety of activities.

The Reserve's Management is advised to offer the population inside the Reserve improved possibilities for their agricultural production; on economic grounds an expansion of peanut and pig enterprises is recommended. Other crops, which are economically attractive and easily transportable should also be introduced. To allow an income improvement, additional activities, such as further processing of timber and enhanced usage of non-timber products should be promoted. Nevertheless, before new options are offered their sustainability needs first to be appraised first.

Resumen

Sistemas de Produción y Estrategias Campesinas en el Sur de Bolivia

Christina Seeberg-Elverfeldt

En la Reserva Nacional de Tarquia y su zona de influencia del Valle Central, la actividad socio-económica tradicional de la población rural esta basada en la agricultura y el ganado transhumante. Debido a la escasez de pasto, cada año los productores del Valle Central llevan su ganado a la Reserva donde pastorean por seis meses en pastos forestales. En Tariquía, los productores son agricultores de subsistencia, y el transporte de sus productos esta limitado por la falta de caminos. En el Valle, los productores orientan su producción a los mercados, pero en su mayoría son de pequeña escala. La discusión sobre los sistemas de supervivencia y estrategias campesinas resulta que las viviendas, especialmente las pobres y de alto riesgo, se adhieren a un portafolio de actividades que aseguran su supervivencia. Por ende, el objetivo de este estudio fue de evaluar los sistemas de producción y la diversificación de estrategias de supervivencia y su influencia mutua.

Los datos fueron recolectados de un grupo de viviendas escogidas al azar en dos comunidades (dentro y fuera de la Reserva) usando métodos cuantitativos y cualitativos. Un análisis de margen neto fue utilizado. Aplicando exámenes estadísticos, una comparación fue realizada en referencia a las diferencias del rendimiento de producción y la diversificación de las estrategias de supervivencia.

Los cálculos económicos revelan que los índices de productividad y rentabilidad de las viviendas fuera de la Reserva eran significativamente mas altos que las de dentro. Indicadores adicionales de rendimiento demostraron resultados similares. Varios indicadores de vivienda, específicos del área, fueron seleccionados, tomando en cuenta la diversificación dentro del sistema productivo, de estrategias de supervivencia (actividades adicionales a la agricultura) y migración. Una alta diversificación de actividades no agrícolas dentro de la Reserva es revelada, mientras que los sistemas de producción son mas diversificados afuera. Sin embargo, en total no hay diferencias significativas observadas en términos de diversificación. El rendimiento dentro de los sistemas de producción no esta relacionado a la búsqueda de una variedad de actividades.

La Administración de la Reserva puede ser aconsejada a ofrecer a la población dentro de la Reserva una mejora de su producción agrícola; bajo términos económicos una promoción de la producción de maní y cerdos es aconsejable. Mas cultivos, que son económicamente atractivos y fáciles de transportar, deben ser introducidos. Para permitir una mejora en los ingresos, otras actividades como ser el procesamiento de madera y mayor uso de productos no maderables debe ser promocionado. Sin embargo, para que nuevas opciones puedan ser introducidas, un análisis de sostenibilidad debe ser realizado primero.

Zusammenfassung

Produktionssysteme und Überlebensstrategien in Südbolivien

Christina Seeberg-Elverfeldt

Im Nationalreservat Tariquía und seiner westlichen Randzone, dem Valle Central, sind traditionelle sozioökonomische Aktivitäten der ländlichen Bevölkerung die Landwirtschaft und transhumante Viehhaltung. Aufgrund von Futtermangel bringen die Bauern aus dem Valle Central ihr Vieh jedes Jahr in das Reservat, wo es sechs Monate auf den Waldweiden bleibt. In Tariquía betreiben die Haushalte Subsistenzlandwirtschaft, da der Anschluss und somit der Transport ihrer Produkte zu den umliegen Märkten stark eingeschränkt ist, denn es führen keine Strassen in das Gebiet. Im Valle sind die Haushalte stärker marktorientiert, jedoch handelt es sich hauptsächlich um Kleinproduzenten. In der Diskussion um die Überlebensstrategien (livelihood strategies) steht zur Debatte, dass Haushalte, und besonders die armen dem Risiko ausgesetzten Haushalte, eine Bandbreite an unterschiedlichen Aktivitäten unterhalten, um ihr Überleben zu sichern. Damit ergibt sich die Zielsetzung der Studie, die Leistung der Produktionssysteme und die Diversifizierung der Überlebensstrategien zu untersuchen und der Frage nachzugehen, welche Beziehungen zwischen beiden Variablen bestehen.

Die Daten sind mit Hilfe von quantitativen und qualitativen Methoden erhoben und eine zufallsverteilte Stichprobe von Haushalte in zwei Gemeinden (innerhalb und außerhalb des Reservats) ausgewählt worden. Die Analyse beinhaltet Deckungsbeitragsrechnungen für alle Haushalte. Mit Hilfe statistischer Tests wurde die Produktionsleistung und Diversifizierung der Überlebensstrategien verglichen.

Anhand von ökonomischen Berechnungen wird aufgezeigt, dass die Produktivität sowie die Rentabilität der Haushalte außerhalb des Reservats signifikant höher ist als innerhalb. Weitere Leistungsindikatoren zeigen ähnliche Ergebnisse auf. Die Überlebensstrategien-Indikatoren wurden spezifisch in Bezug auf das Projektgebiet ausgewählt und beziehen sich auf drei Bereiche: die Diversifizierung innerhalb des Betriebs, die nicht-landwirtschaftlichen Aktivitäten und die Migration. Innerhalb des Reservats findet man eine höhere Diversifizierung der nicht-landwirtschaftlichen Aktivitäten, wohingegen die innerbetriebliche Diversifizierung außerhalb weit höher ist. Letztendlich kann jedoch statistisch gesehen kein signifikanter Unterschied in der Diversifizierung zwischen den Gemeinden aufgezeigt werden. Niedrigere Leistungen innerhalb der Produktionssysteme können nicht in Verbindung gebracht werden mit einer stärkeren Durchführung unterschiedlichster Aktivitäten.

Es wird dem Management des Reservats empfohlen, die landwirtschaftliche Produktion der lokalen Bevölkerung des Reservats zu unterstützen um ihre Leistungen und Effizienz zu steigern. Aufgrund der ökonomischen Berechnungen sollte ein Schwerpunkt auf eine Vergrößerung des Erdnussanbau und der Schweinezucht gelegt werden. Weitere Kulturpflanzen, welche ökonomisch von Interesse sowie leicht zu transportieren sind, sollten eingeführt werden. Um eine Einkommensverbesserung zu gewährleisten, sollten weitere Aktivitäten, wie die Weiterverarbeitung von Holz und eine verbesserte Nutzung von Nicht-Holz-Produkten gefördert werden. Jedoch sollten alle Optionen, bevor sie eingeführt werden, auf ihre Nachhaltigkeit überprüft werden.

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Acronyms

ar	arroba = 11.5kg
Bs	Bolivianos (for the year 2000: 1 US$ ~ 6.3 Bs)
c	carga = 8 arrobas > 92kg (maize: 6 arrobas > 69kg)
C	Chocloca
FC	Fixed Costs
GO	Gross Output
GM	Gross Margin
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
ha	hectares
NFY	Net Farm Income
No	Number
OTB	Organización Territorial de Base ~ Rural community association
pers. comm.	personal comment
PR	Puesto Rueda
PROMETA	Protección del Medio Ambiente Tarija – Protection of the Environment Tarija
q	quintal = 46 kg
RNFFT	Reserva Nacional de Flora y Fauna Tariquía
SERNAP	Servicio Nacional de Áreas Protegidas
TLU	Tropical Livestock Unit
VC	Variable Cost
∅	average

Glossary

a medias	special type of land rent agreement
Chaco, ~eño	Region in the Department Tarija towards the east of the Reserve, ~ person from this region
comunario	villager
corregidor	local judge
criollo	Creole
desmonte	forest plot with an inclination of more than 50%
jornaleros	contract workers
monte	forest/remote area
municipio	municipality
pro-indiviso	pastures managed as common property
Valle Central	Central Valley

1. Introduction

1.1. Problem statement

At the United Nations Millennium Summit held in New York in September 2000 it was generally agreed that the major development goal was to halve global poverty by the year 2015 (IFAD, 2001). This was adopted as an international development target and serves to reaffirm the mandates of bilateral and multilateral agencies and international organisations, such as the World Bank, the Food and Agricultural Organisation (FAO) and the International Fund for Agricultural Development (IFAD). The global debate is therefore concerned with strategies for poverty alleviation, and specifically for the rural poor, who are now the focus of many action plans. The FAO justifies the eradication of poverty as a development goal, stating: 'Hunger is predominantly a rural problem. Hence raising the productivity and income-generating capacity of small farmers and reinforcing their resilience to shocks can often play a key role in cutting the incidence of hunger (FAO, 2001).'

This has resulted in production systems of farming households in developing countries to become the target for many development programmes, as they provide the subsistence basis as well as the main source of income for the majority of rural families. A key aim is to provide information which can assist the farmers in their resource management, enabling them to improve their food security. However, the objectives of the project and the farmer differ. The farmer sees the production process as part of his livelihood, and integrates the usage of the sometimes scarce resources of land, labour, capital, time and management knowledge available to him with additional activities, whereas development workers often see the production process in isolation, aiming at improving the productivity and profitability of only the farming systems. In many projects the farmers are still not seen as the central point, and all the elements of their situation, circumstances and priorities are overlooked.

More recently, it has come to be recognised that the entire livelihood security of the rural poor needs to be addressed, of which the farming system forms a part, covering the capabilities, assets (stores, resources, claims and access) and activities required for making a living (CHAMBERS AND CONWAY, 1992:7). The multidimensional characteristics of sustainable livelihoods – environmental, economic, social and institutional have to be taken into account (ASHBY AND CARNEY, 1999 *in* WARNER, 2000:4). Hence a firm understanding of both the production system as well as livelihood characteristics needs to be elaborated to provide the basis for the design of rural development programmes and policy formation .

1.2. Objectives

Main objective

- The present research attempts to analyse the prevailing land use systems, concentrating on the production systems and livelihood strategies of communities within the National Reserve of Flora and Fauna Tariquía and one of its influence zones, the Valle Central, in the Department of Tarija, Southern Bolivia.

Secondary objectives

- Description of the production systems, using performance indicators, analysing the farm income and productivity of the various crop and livestock enterprises, and a comparison between the communities inside and outside the Reserve.

- Description and analysis of the diversification of the household livelihood strategies, and their interdependencies, as well as exploring the differences in the strategies inside and outside the protected area.

- Identification of the relationship between the production performance of the farming systems and the diversification of livelihood strategies. Analysis of the difference between the community inside and outside of the Reserve.

The study on hand has been carried out in conjunction with the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), within their programme 'Management of Protected Areas and Bufferzones' (Manejo de Áreas Protegidas y Zonas de Amortiguación – MAPZA). This programme has already been working for several years in some of the protected areas and their influence zones in Bolivia. The project work in the National Reserve of Flora and Fauna Tariquía (Reserva Nacional de Flora y Fauna Tariquía – RNFFT) started in May 2000. MAPZA is collaborating with the local non-governmental organisation PROMETA (Protección del Medio Ambiente Tarija) which is in charge of the management of the Reserve.

The study's objectives have been derived in accordance with MAPZA and PROMETA, as well as the researchers' interest. It was especially relevant for the MAPZA project to obtain an outline of the land use systems prevalent in this area. The study provides an important input into the better understanding of the prevailing production systems and management practices, the constraints under which the farmers are undertaking their cultivation and livestock keeping activities, as well as the livelihood strategies pursued by the local population. - Furthermore it is hoped that the results and recommendations will be of use to the communities themselves and give stimulation and input into the management of their production systems and how possibly to improve these. The Reserve's Management can draw on the recommendations to support the sustainable development of livelihood and land use activities of the local communities.

1.3. Outline of the study

After this brief introduction of the research topic, the theoretical framework for the study will be explained, starting with the outline of the research questions and hypotheses based on the objectives of the first chapter. In the literature review the main concepts regarding the issues of interest for the research are defined. The conceptual framework for the study draws on these and uses or adapts them to the study on hand and explains the main working variables and indicators. In the third Chapter, an overview of the framework conditions is given which allows the reader to conceptualise the characteristics of the study area and to put the following chapters into context. In Chapter four the chosen methodology, the research design and instruments are illustrated. The results are presented in Chapter five, together with a discussion regarding the implication of the results. In the final chapter conclusions and recommendations drawn from the results are given, along with a short appraisal of the research methodology. The epilogue provides a summary of the insights gained whilst conducting this study.

2. Theoretical Framework

2.1. Research questions and hypotheses

According to the objectives outlined in the first chapter the following research questions (R) have been investigated and used as a guide for the empirical research of the study. Each question implies a hypothesis and consequently a null-hypothesis (H_0)[1].

R1: Is the performance of the production systems of the communities inside the National Reserve less efficient in comparison to the communities in the Valle Central?

$H_0$1: There will be no significant difference between the productive performance of the farming systems of the communities inside the National Reserve compared to the communities in the Valle Central.

R2: Are the household livelihood strategies of the local population inside the Reserve more diversified compared to the communities outside?

$H_0$2: There is no significant difference between the diversification of the livelihood strategies and production systems of the communities within the Tariquía Reserve and the communities outside.

R3: Is there a relationship between the productive performance of the farming system and the diversification of the livelihood strategies of the studied communities?

$H_0$3: There is no significant relationship or difference between the productive performance of the farming systems and the diversification of the livelihood strategies of the communities inside and outside the Reserve.

Initially a further question was considered for investigation: What perception does the local population have regarding the impact of the transhumant cattleholding on their production systems and the environment? It is hypothesised that the transhumant cattleholding has a negative impact on the environment, hence the aim was to investigate whether the local population perceives the cattle to have a negative impact on their production systems and natural resources in the Reserve. However, even though this question is very relevant for the Reserve Management, due to time and space limitations it was not possible to include the issue in this study.

2.2. Literature Review

To understand the prevailing land uses of the farmers, various characteristics can be selected and analysed. This study focuses on the socio-economic characteristics of the production systems, which are described with the help of the gross margin analysis, allowing several indicators and variables to be obtained. Furthermore, it is not only the productive performance of the land use systems which typifies them, but also the

[1] It is the H_0 which needs to be rejected or accepted according to the results obtained during the statistical analysis of the data.

different livelihood strategies pursued by the local population. These concepts, and related terms and definitions employed in this study, are explained in due course.
As farming households are the main target of this study, these need to be clearly defined. There are two parts to this, the farmers and the household. ELLIS (1993:13) defines **farmers** as:

> *'Peasants are households which derive their livelihoods mainly from agriculture, utilise mainly family labour in farm production, and are characterised by partial engagement in input and output markets which are often imperfect or incomplete.'*

They have a multi-activity character, as apart from their productive agricultural activities, they are involved in further non-farm activities of which some are non-market tasks and others rely on working markets. A strong reliance on family labour is a defining economic characteristic and access to the resource land serves as basis of their livelihood. Furthermore, they demonstrate a varying rather than total commitment to the market, as the proportion of farm output which is directly consumed by the household, rather than sold in the market is quite substantial, and constitutes the subsistence basis of their livelihood (ELLIS, 1993).

Households are a social unit defined as sharing the same abode or hearth, and usually constituting a sub-set of the family. It is assumed that household resources are pooled, the income is shared and decisions are made jointly by adult household members. Often the household is associated, rather than the larger family, with the farm as a production enterprise (ELLIS, 1993:14). From an economic institution viewpoint, DE HAEN AND RUNGE-METZGER (1990:5) define the household as:

> *'The smallest social group (institution) in which human beings – generally linked to one another through a common housing and / or a common cooking unit live in particularly close social, cultural, and economic relations in order to satisfy the material and non-material needs.'*

Sometimes the term family is used interchangeably with the term household. Even though they are not the same, and family defines the social unit of a biologically-oriented relation or kinship (DHARMAWAN, 2001), in this study they carry the same connotation.

The **production systems** of these farming households are the focus of this study's research. These are defined according to the level or hierarchy of the system (DOPPLER, 1991). For this investigation, they imply the agricultural activities - the livestock farming and crop enterprises of the farming household. Sometimes the term farming system is employed, they are used interchangeably in this study. The **farm income analysis** is applied to characterise them, as it reflects the profitability of a farm on an annual basis, both of the farm as a whole as well as each constituent enterprise. According to BROWN (1979), the calculation of the net farm income represents the reward to farm family for their labour, capital and management invested in the farm during the particular year being analysed. The separation of the analysis of enterprises

allows the examination of several features: the relation between individual enterprises on a farm and their relation with the farm as a whole; the profitability of each enterprise relative to the resources used; the comparison of the relative efficiency of various enterprises on farms similar in type, size and farming conditions; and as a basis for making rational decisions about the kind and size of enterprise, for calculating the costs of production, and for fixing the price of farm produce (BROWN, 1979:12).

The profitability of each enterprise can be measured at various stages. Farm enterprise **gross output** is a preliminary measure of income. It assesses the performance purely in terms of benefits it yields not considering the production costs. It is calculated by multiplying the total volume of the marketable production (home consumption and sales) with the obtained market price (BROWN, 1979:13). It is used as an indicator for **productivity,** for comparisons between different enterprises. Ratios such as gross output per hectare or per labour unit are computed to indicate the productivity of farm operations (DILLON AND HARDAKER, 1980: 43). They allow to draw comparisons between enterprises with regard to some input resource such as labour, land or capital which might be in short supply and put a constraint on the production.

Costs can be divided into two main groups: variable and fixed costs. The **variable costs** are specific to the farm enterprise and vary more or less in direct proportion to the level of the particular enterprise (DILLON AND HARDAKER, 1980: 44). Variable costs for items, such as feed, seed, fertilizer, spray materials, and casual labour, can be controlled to some extent and are not incurred when there is no production (BROWN, 1979:16). The distinction between casual labour, normally regarded as a variable expense, and permanent labour, normally viewed as a fixed expense, maybe somewhat arbitrary on occasion. Sometimes they are employed year-round, but paid on a 'task' basis, which can be attributed as variable costs. Other times labour is hired on a casual basis, yet may be allocated to tasks of an essentially overhead nature, such as maintenance work. In view of such ambiguities, it is important to always record full details of casual labour expenses included in an enterprise gross margin (DILLON AND HARDAKER, 1980:48)

In contrast the **fixed costs** for items such as taxes, insurance, interest, rent, physical contingencies and depreciation on buildings and machines, are incurred whether or not there is production (BROWN, 1979:16-19).

Farm enterprise **gross margin** is obtained by subtracting the variable costs from the gross output of the enterprise. It shows the **profitability** of an enterprise, allowing comparisons between various activities. However, valid comparisons can only be made in terms of a production unit common to all of the enterprises or farms being compared. This unit can be the land area, if the land used by each activity is equally suitable. It could be per unit of labour, per US$100 of capital invested, per breeder unit or per head of livestock. In tropical countries, where the family labour is an important factor, the gross margin per unit of labour may be the most appropriate base for comparison (MAKEHAM AND MALCOLM, 1986: 64). No account is taken of the demands the enterprise places on those farm resources represented by the fixed expenses. Rather,

the gross margin measures the contribution the enterprise makes towards these fixed expenses and to the farm profit. It is a particularly useful method for budget planning, as a change in the gross output or variable costs when changing the level of a particular enterprise is automatically reflected in the enterprise gross margin. Consequently the fixed resources can be reallocated or their supply readjusted accordingly (DILLON AND HARDAKER, 1980:48).
- Shortcomings of this method are that fixed costs are not included and the linearity of variable production costs is assumed, even though these do not always increase proportionally with an increase in production. Thus, recommendations for the expansion of certain enterprises based on a comparison of these with different cost items need to be carefully assessed. Additionally physical and financial limits, such as availability of suitable land, shortage of labour in peak periods and of credit need to be taken into account.

Furthermore the efficient usage of resources will be assessed. Efficiency refers to a ratio of what is used to what is produced. Making the most of limited resources means getting the most output from inputs (technically efficient) and achieving as many financial and personal objectives (economically efficient) as possible (MAKEHAM AND MALCOLM, 1986:31). The relationship of the variable costs per gross output indicate the **efficiency of the usage of working capital** for the enterprise. The working capital requirements for the specific enterprise are assessed and conclusions drawn regarding the capital extensiveness or intensiveness of the enterprise and whether it is a low or high input system. Additionally, the **capital productivity** indicator has been calculated to evaluate the return per working capital invested for the crop enterprises and the return per unit of fixed capital invested for the livestock enterprises. This can be compared to the opportunity cost of the capital, indicating that when the resource (working or fixed capital) is used in a certain way, then the opportunity to use it in another way (for example depositing it in a bank account) is given up. This indicator does not allow comparisons on the profitability of an activity within the whole farm. Factor productivity indicators only give a suggestion regarding the suitable usage of scarce production resources (STEINHAUSER *et al*, 1992:180-182). The distinction regarding the returns of different types of capital for the two sectors has been made to show the importance of each type. Within the crop enterprises the working capital requirements constitute considerable expenses, whereas in the livestock farming sector the actual cash expenses are not so crucial, and the fixed capital constitutes an important asset to the farming household.

Finally the **net farm income** is calculated, which is the principal measure of the year-by-year **profitability of the farm as a whole**. It is the reward for the labour, capital, and management contributed by the farm family during the year. It is obtained by subtracting the total cost for all enterprises, except the imputed values for farm family labour and capital, from the total gross output of all enterprises (BROWN, 1979:21). The **land use productivity** is then calculated by dividing the net farm income by the total farm land and allows for comparison of farms.

Unfortunately, it was not possible to obtain data on family labour and working hours spent on each enterprise, as the farmers found it very difficult to give estimates. Only for the three most important crop enterprises (maize, potatoes and peanuts) was this worked out with the households, and the corresponding calculations made regarding the **intensity** and **productivity of labour**. Intensity indicators describe the ratio of input factors employed in production (HENRICHSMEYER *et al.*, 1986: 554). Both give an indication of the labour performance of the households.

In the definition of peasants given above it has already been mentioned that it is not just the agricultural activities characterising the households, but their engagement in multi-activities, the **livelihood** of farming households, which is of interest. The concept has been discussed widely and various definitions exist. CHAMBERS AND CONWAY (1992:6) describe livelihoods as:

> *'the ways in which people satisfy their needs or gain a living.'*

ELLIS has been working extensively on this topic and defines it (1998:4):

> *'to be more than just income, it encompasses income, both cash and in kind, as well as the social institutions (kin, family, compound village and so on), gender relations and property rights required to support and to sustain a given standard of living. Livelihood also includes access to, and benefits derived from, social and public services provided by the state such as education, health services, roads, water supplies and so on. A livelihood may be simply said to be a 'universe' of several types of ways of securing human existence. Thus, a livelihood can be viewed as a mix of social and economic actions oriented towards maintaining human existence, including all efforts prepared to face emergency situations and defend life against difficulties and hardships.'*

Hence livelihood does not mean just obtaining a large enough income to survive but entails the understanding of a 'complex of human ways' (DHARMAWAN, 2001:80). It is not simply survival[2], but rather denotes households pursuing a variety of actions to ensure livelihood security. To safeguard this security, SCOONES (1998:7-8) points out that four types of livelihood resources are necessary to support different strategies. These are:

1. Natural capital – natural resources (soil, water, air) and environmental services
2. Economic or financial capital – the capital base
3. Human capital –education, skills, knowledge and ability to work
4. Social capital – social resources such as networks and relations

Usually these resources are combined and at any scale livelihoods are composed in complex ways, with multiple and dynamic portfolios of different activities, often improvised as part of an on-going 'performance'. Obviously in different communities, cultures, and countries the access to and availability of the resources will vary.

[2] thus the German translation 'Überlebenstrategie' does not reflect the term livelihood adequately

Because strategies are thus diverse, it is important to analyse the livelihoods from different perspectives.

It is the diversity of activities which characterises many farmers, and rural households are known to be engaged in multiple activities. Rural livelihood diversification (ELLIS, 1998:4) is then defined as:

> *'the process by which rural families construct a diverse portfolio of activities and social support capabilities in order to survive and to improve their standards of living'.*

The causes for adopting one of several rural livelihood pathways can be found in situations and a fragile production environment which confront specific households. External influences such as environmental hazards or financial insecurity as well as internal household factors, such as disease or age, define these processes. The main determinants identified for diversification are seasonality, differentiated labour markets, risk strategies, coping behaviour, credit market imperfections, insufficient economic funds and intertemporal savings and investment strategies. The impact of these determinants – and coping with shocks contribute therefore to the adoption, and adaptation over time, of diverse rural livelihoods. The causes and consequences of diversification are differentiated in practice by location, assets, income, opportunity and social relations; and it is not therefore surprising that they manifest themselves in different ways under differing circumstances (ELLIS, 1998:3-11). Over time the portfolio of activities changes and will be adjusted by the household.

SCOONES (1998:9) demonstrates three possible diversification strategies pursued by rural people:

1. **agricultural intensification or extensification** – between capital-led and labour-led intensification,
2. **livelihood diversification** – the active choice to invest in diversification for accumulation and/or diversification aimed at coping with temporary adversity or more permanent adaptation of livelihood activities,
3. **migration** –different migration causes, effects and movement patterns.

Commonly these strategies are not pursued in isolation, rather a combination or a sequence is observed. The local circumstances and conditions influence decisions with regard to the pathways followed.

The term multiple employment or **pluri-activity** can be used to describe farm households that engage in activities in addition to farming their own land and animals (FULLER AND BRUN, 1990:149). These activities may include: 1. **employment on other farms**, e.g., being hired as farm labourers, 2. **para-agricultural activities** such as food processing on their own farm, e.g. making honey for sale, 3. **other non-agricultural activities on the farm**, e.g. furniture making, 4. **off-farm activities**, e.g. wage labour. Especially in traditional rural agricultural-based communities many forms of activities

take place in a diverse non-economic action based strategy. These include the social networking, keeping up relationships with the extended family and friends living in other communities, exchange of agricultural products and seeds, and traditional celebrations.

The effects of diversification of livelihood strategies is an area which is continuously investigated, and positive and negative impacts are detected. For a discussion on the effects of diversification see ELLIS (1999) and REARDON (1999). Usually it is observed that a diverse portfolio of activities contributes to the sustainability of a rural livelihood because it improves long-run resilience in the face of adverse trends or sudden shocks. In general, increased diversity promotes greater flexibility because it allows more possibilities for substitution of opportunities that are in decline with those that are expanding. According to ELLIS (1998:17) it is possible to reduce the risk of overall income failure by diluting the impact of failure in any single income source; to reduce the intra-year income variability by diluting the effect of seasonality in farm based income streams; and to reduce inter-year income variability resulting from instability in agricultural production and markets. REARDON (1999:21) concludes that rural non-farm activities affect agriculture in a number of ways and ambiguous results are often evident. Rural non-farm employment can reduce the pressure (of farming activity) on land in fragile areas. In this regard, alternative income sources may shift peoples' attention from one resource to another. By combining income sources, peasants do not necessarily depend too much on risky farm production. This evidence supports the belief that livelihood diversity can guarantee a sustainable livelihood. Therefore the removal of constraints to, and expansion of opportunities for diversification are desirable policy objectives because they give households more capabilities to improve their livelihood security (ELLIS, 1998:25).

2.3. Conceptual Framework

Drawing on the concepts from the literature review, the following framework has been established for the study on hand. Figure 1 shows the two main variables: 'Productive Performance' and 'Livelihood Strategies' and the corresponding working variables which are used for describing the socio-economic characteristics of the prevailing land-use systems .

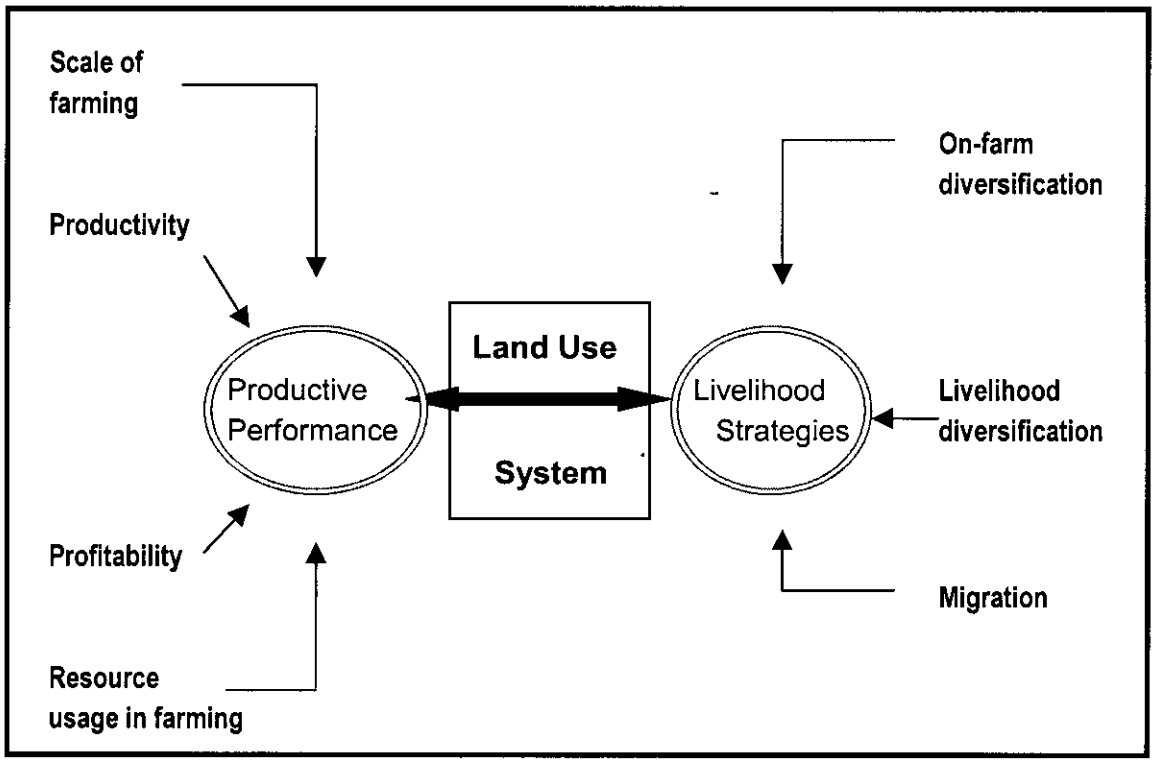


Figure 1. Conceptual Framework of main and working variables (in bold) for land use system description
Source: own graphical presentation

According to the first question, the difference in the productive performance of the farming systems between the two groups will be analysed. This entails a descriptive part, but also an explorative question. - The independent variable (X_1) is the location of the households either from the Community Puesto Rueda inside the Reserve Tariquía or from the Community Chocloca outside the Reserve Tariquía. Four dependent variables (Y_{1-4}) have been identified to assess the productive performance of the farming systems. These are described with the help of various indicators, which are summarised in Table 1.

Table 1. Variables and Indicators for the production performance description and analysis

Dependent Variable	Indicators
Y_1: Scale of farming	i. Hectare size for each crop enterprise ii. Average herd size for each species iii. Total cultivated area and number of different species held/grand total number of animals in Tropical Livestock Units (TLU)
Y_2: Productivity	iv. Productivity of each enterprise (Gross output per ha/animal) and grand total v. Capital Productivity for crop and livestock enterprises (Gross margin per variable costs/fixed costs) vi. Productivity of labour of selected crop enterprises (Gross margin per person day (calculated as average of household and hired labour))
Y_3: Profitability	vii. Profitability of crop and livestock enterprises (Gross margin per ha/animal) and grand total viii. Total profitability (Net Farm Income)
Y_4: Resource usage in farming	ix. Capital efficiency of crop/livestock enterprises (Variable costs per Gross output) and grand total x. Labour intensity for selected crop enterprises (total labour input per ha) xi. Land use productivity (net farm income per hectare of total farm land)

Four working variables have been selected for the performance analysis: the scale of farming, productivity, profitability and the resource usage in farming of the production systems. To each variable various indicators are assigned; some are applied to all crop and livestock enterprises, as well as the sum of all enterprises and the entire farm, whereas others are only applied to specific enterprises. Firstly, the results of the analysis of each indicator will be briefly portrayed, in reference to the crop, the livestock enterprises and the entire farm. They are then discussed in turn. In order to achieve a ranking for the production performance, only specific indicators most representative for the production systems have been selected. It is not possible to evaluate every single enterprise or every indicator in a ranking scheme, hence the emphasis has been put on the sum of all enterprises (grand total) and total numbers for the entire farm. Every working variable has been assigned one or two indicators and is evaluated on the hypothesis of whether a difference is apparent between the performance of the production systems of the communities within the National Reserve and outside in the Valle Central.

The variables and indicators have been selected according to their applicability for describing the productive performance of the farming systems. The productivity and profitability indicators demonstrate purely economic performance, these were explained in the literature review. Others, such as scale of farming are not so much an economic performance indicator but do allow conclusions regarding the size of the production systems. The resource usage indicators assess the usage of the input resources

capital, labour and land in farming. As explained above, the capital efficiency indicator examines the working capital requirements of the enterprises per gross output, and the labour intensity indicator the total labour input in persondays per hectare. The land use productivity indicator shows the output (net farm income) per input factor (total farm land) relationship. A further indicator of interest is the degree of commercialisation for conclusions regarding the dependence on subsistence production. However, it has not been assessed due to time and space limitations.

It is known that household income as a welfare indicator is considered prone to several flaws. Income in rural households varies from year to year depending on the output of farm production and prices obtained for output sales. Income also varies seasonally, causing practical difficulties for the timing of sample surveys and the accuracy of recall of crop sales and prices (ELLIS, 1998:9). However, the aim of selecting these specific indicators was to obtain an indication and trend of the performance of enterprises which might be found to be economically advantageous to promote, as well for comparisons between the two communities. Furthermore, it is also known that many small farmers usually do not manage their farms rationally and take decisions not purely to maximise profit. This has led to the second part of the study, looking at the entire livelihood system in order to be able to include some other strategies pursued by the households apart from only assessing the production performance.

As has been discussed, it is the entire livelihood system on which the farmer depends. The capability to diversify income sources, as well as livelihood strategies is of utmost importance to the rural poor. This is partly because poor households are more vulnerable to seasonal and risk factors than better off households, but also because they lack assets. They may be landless or near landless, and possess few or no livestock. Without the capability to produce enough food on own account, the poor must diversify their strategies to survive. As it is hypothesised that the farming households inside the Reserve have a lower productive performance, the second question assesses whether their diversification of livelihood strategies is therefore higher.

There are two parts to this question, one is descriptive and explains the different strategies pursued. The other explores and analyses whether there are any statistically significant differences between the community inside and the community outside the Reserve. The independent variable (X_1) is again the location of the households either from Community Puesto Rueda inside the Reserve Tariquía or Community Chocloca outside the Reserve Tariquía. The dependent variables (Y_{1-3}) appraise the pathways and levels of diversification of the livelihood strategies.

Based on the concept of the pathways followed by rural people pointed out by SCOONES (1998) and discussed above, three strategies have been identified for this study which have been assigned to three working variables as indicated in Table 2. The on-farm diversification will be appraised, assessing the numbers of crops and animals farmed, as well as the function categories to which these can be assigned.

Table 2. Variables and Indicators for livelihood description and analysis

Dependent Variables	Indicator
Y_1 : On-farm Diversification	- Number of different crops cultivated i. plant composition ii. function categories - Number of different livestock species held iii. livestock composition iv. function categories
Y_2: Livelihood Diversification	v. Para- and non-agricultural activities vi. Non-monetary exchange of products vii. Off-farm employment
Y_3: Migration	viii. Migration

For the second strategy of livelihood diversification, according to FULLER AND BRUN (1990) the pluri-activities of farming households will be investigated. Three indicators have been selected, the para- and non-agricultural activities, such as simple manufacturing of products, and fishing and hunting; the non-monetary exchange of products as a means of using informal markets; and off-farm employment to generate additional income. - Finally migration as a third strategy is assessed. Various push and pull factors have been mentioned in the literature, such as income differentials to be pull factors and seasonality, risk, market failures, erosion of assets, landlessness, and disasters as push factors (ELLIS, 1998:16). The dynamics of migration will be described, and its prevalence in the area investigated.

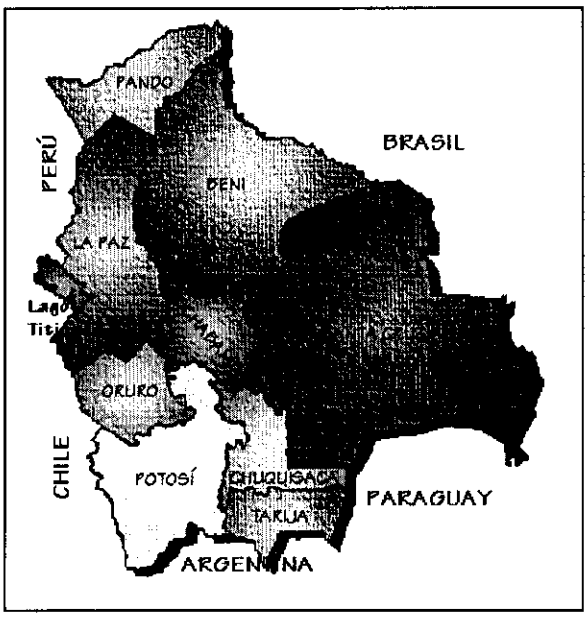
An important branch of enquiry in this area has not been examined: - the interrelationship of diversification strategies with natural resource management and the environment. Especially within the discussion of the management of farming systems in a Nature Reserve, the sustainability of the production and livelihood strategies is crucial. Due to time and space limitations this aspect has not been considered. However, it needs to receive attention in further planning for the management of the Reserve and its influence zone.

Various factors influence the diversification of strategies mentioned in the literature review, such as resource and financial access, as well as social, technological and natural factors. As the first part of the investigation concentrated on the productive performance of the farming system, the third question as outlined in Chapter 2.1., assesses the strength of the relationship between this performance and the livelihood strategies of communities inside and outside the Reserve and whether a lower performance influences the pursuit of a higher number of different strategies. It focuses on whether the poorer (equated with lower productive performance in this study) have a highly diversified livelihood strategy, or whether this is observed amongst all farmers equally. Nevertheless, it is known that it is always a combination of different factors, never just one in isolation, that determines the diversification of activities found in an area. However, an insight into the determination of the diversification observed in this area can be given and provides an input for management recommendations. It is an explorative question and looks at the two main variables and their relationship.

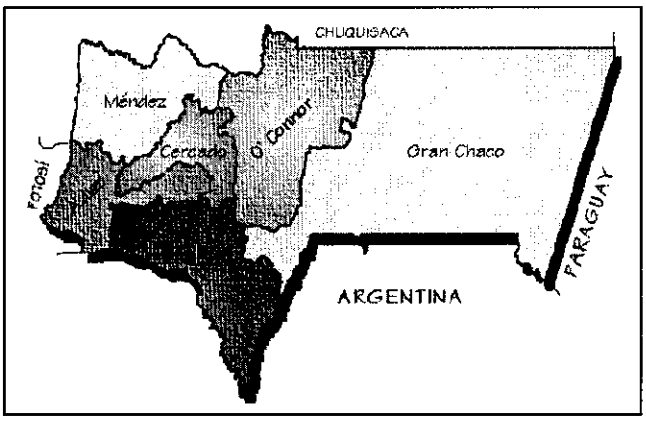
3. Frame Conditions

3.1. Geographic and climatic characteristics of the Reserve Tariquía and Valle Central

The study area is situated in southern Bolivia, in the Department Tarija (see Map 1 and 2). The Department is composed of six provinces which are subdivided into cantons and '*municipios*'. Tarija is the capital. The National Reserve Tariquía is located within four provinces: Arce, O'Connor, Gran Chaco and Avilés. The Valle Central lies to the west of the Reserve in the provinces of Arce, Avilés and Cercado (see Map 3).



Map 1. Departments of Bolivia
Source: www.ine.gov.bo

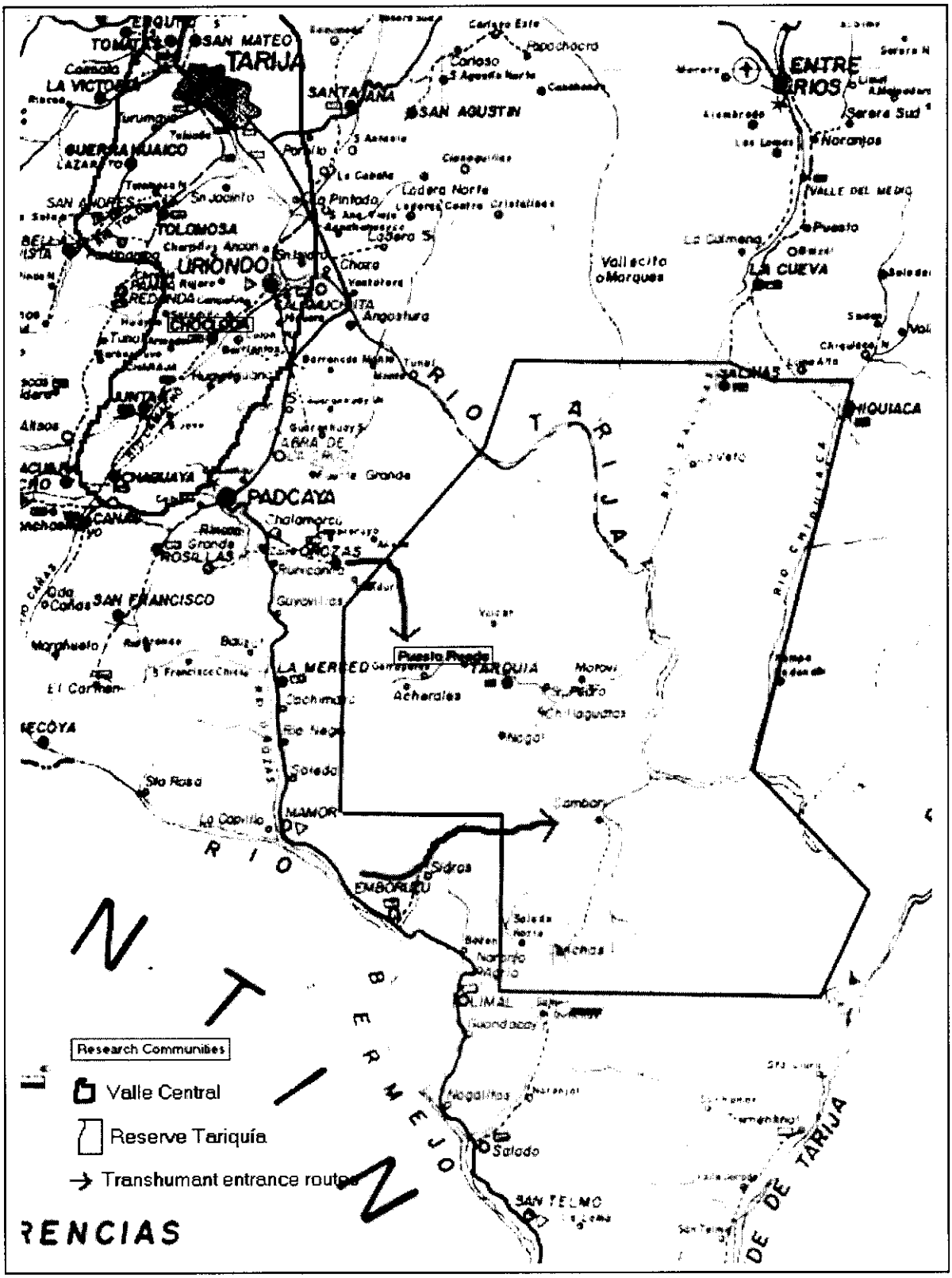


Map 2. Provinces of Tarija
Source: www.ine.gov.bo

The Reserve was created in 1989 and covers an area of 250,000 hectares. It belongs to the National Service of Protected Areas (Servicio Nacional de Áreas Protegidas - SERNAP) which coordinates the functioning of all Protected Areas in Bolivia and is in charge of their integral management. Since its creation, PROMETA has been managing the Reserve and in 1997 with the Agreement of Co-management, a Director has been assigned, who is both in charge of the Reserve Management as well as PROMETA. The Reserve corresponds to Category II according to the IUCN classification of protected areas[3].

In 1997 the Comité de Gestión (Management Committee) of the Reserve was founded, according to the Ley del Medio Ambiente (Law of the Environment) and Ley de Participación Popular (Law of Popular Participation). This allows representatives of the cantons of the Reserve and other social and institutional actors of the region to participate in the design and execution of the management plan, as well as

[3] IUCN Category II definition - Type: National Park; Main management objective: Protect natural and scenic areas of national and international significance for spiritual, scientific, educational, recreational or tourist purposes.



Map 3. The location of the National Reserve Tariquía and the Valle Central

programmes and projects which are planned for the area. PROMETA, apart from its management position, is in charge of the protection and control of natural resources in the Reserve; investigation and monitoring programmes; encourages the communities to attain sustainable production and supports the strengthening of organisational structures.

The dominant vegetation within the Reserve is the Bolivian Tucumano Forest, forming part of the Biogeographic Subregion of the Humid Mountain Forest of the Yungas. Climatic conditions in the area vary and depend on elevation and precipitation. Tariquía lies between 700 and 3,200m; the centre of the Reserve (1,000 – 1,700m) has a temperate-warm climate with an average temperature of 21°C and 900-1,200mm rainfall annually (PROMETA, 2000:5). The most elevated areas are found in the west and north-west of the Reserve, and the lowest areas are towards the east and in the south, along the river Tarija. There are several rivers and streams of good water quality in the area. Soils are very variable, in the centre of the Reserve they range between sandy up to young alluvial terraces and in the valleys they are more developed. Only the communities in the north-eastern part of the Reserve are connected by road to other villages, while the Canton Tariquía in the centre of the Reserve is only accessible by two mule trails, both of approximately 60kms (16 hours walk). The community Puesto Rueda, where the interviews have been conducted, is situated in the centre (see Map 3). Picture 1. in Annex I gives an impression of the centre of the Reserve (Pampa Grande) when arriving from the southwest entrance point.

The Valle Central is located in the southern part of the inflection of the eastern Andes mountain chain. Through this inter-andean valley passes the Panamerican Highway coming from La Paz via Tarija leading on to Argentina. The altitude ranges between 1,300 and 2,200m. It has a very dry climate with around 600mm of precipitation annually. The rainy season lasts from November until March, whereas during the remaining year there is little rainfall. The average temperature is 18°C (GOBIERNO MUNICIPAL DE URIONDO, 1997). The natural vegetation is a shrubby dry steppe, and secondary degraded vegetation with plenty of soil erosion. It is characterised by the thorny acacia '*Churquí*' (*Acacia caven*). The soils are moderately developed. Various rivers cut through the micro valleys with strong currents during the summer period, which often cause considerable damage carrying away parts of the roads. The majority of communities are connected with a road network and buses provide public transport within the Department. The community Chocloca is situated approximately 60kms towards the south of Tarija. See picture 2. (Annex I) for an impression of the community.

3.2. Socio-economic characteristics of households

The population in this region of the Department Tarija are '*mestizos*' (of mixed Spanish-Amerindian descent), and are culturally deeply rooted in the area. Most describe themselves to be '*chaqueños*' and their cultural manifestations show these characteristics.

According to the Census conducted in 1992 by the National Institute of Statistics the Reserve has a population of 3,700. Nearly half live in the two communities in the north-east of the Reserve (Chiquiacá and Salinas) and the other half in ten communities in the Cantón Tariquía in the centre. The biggest community Pampa Grande has 357 inhabitants (PROMETA, 2000:23), and Puesto Rueda, with 169 inhabitants belongs to the smaller communities (PROMETA, 1998a). - According to the household definition given earlier, 24 units were identified with an average of 6.5 members (own data). Their

extensive families share the daily workload. Every member has various tasks to fulfil, either in agricultural production or looking after the livestock which are the dominant and traditional activities in the area. Farmers within the Tariquía Reserve are characteristically small-scale producers, with most of their produce directed towards home-consumption. This is true for both crop and livestock enterprises. Reasons for this are the remoteness of the communities and their enormous distance from the market because of a lack of roads. The fact of being in a protected area, where a sustainable land use should be practised, also imposes certain restrictions on the households regarding resource usage. Additionally, farmers have little knowledge about the treatment of diseases affecting their crops and animals. For irrigation, farmers rely completely on rainfall, as collection systems have not yet been built in any of the communities.

In addition, some family members migrate on a temporary basis, and contribute to the household income with their salaries. There used to be a lot of timber extraction, however, since it has become a Reserve this activity has been prohibited. It constituted an important income source to farmers, as they received good prices for the timber when sold outside of the Reserve. Nowadays, some farmers still pursue this activity in order to complement their meagre incomes, even though it is known that it is illegal. Other non-timber forest products are also used, the bark of trees as roofs by the poor families who cannot afford corrugated iron; berries are collected on a minor scale. Farmers used to hunt wild animals with guns, especially when they ate their harvest, and to fish with dynamite. The use of guns and dynamite has now been prohibited, which causes additional resentment against PROMETA, although farmers can still hunt and fish with traditional spears or traps.

In Puesto Rueda none of the houses has electricity or running water. The nearest health station is in Pampa Grande (one hour walk) where a nurse is working with the basic equipment. There is a primary school in the community (first three basic years of schooling), and for the first four years of secondary education the children can attend school in Pampa Grande. To complete their school education they need to go to bigger cities outside the Reserve. In Pampa Grande there is a telephone and a radio can be found in the PROMETA research station (located 45 minutes away from Puesto Rueda on the way to Pampa Grande).

In the Valle Central the population density is 15 habitants per km^2 (DUPONT, 2000:17). According to the 1992 census, the canton of Chocloca has 1,230 inhabitants and the community Chocloca 499 (GOBIERNO MUNICIPAL DE URIONDO, 1997). However, the community itself every year conducts a new demographic census, and in 2000 there were 799 inhabitants in Chocloca living in 147 households (unpublished data from Community Chocloca). Households on average have 6.6 members, however only 3.6 of these actually live together as many children leave the community for education reasons (own data). The main activities are agricultural production, livestock farming and migration. The production is more market-oriented than in the Reserve. The community is connected with Tarija by road and an extensive road system exists in the Valle Central. Farmers either take their produce to Tarija on the local buses or sell it to haulage contractors passing through the villages with big lorries, who eventually sell

the products in markets further away such as in Santa Cruz or Sucre. However, a large share of the produce is still used for home consumption, and depending on the household and the crop or livestock, only about 20 to 50% is sold. Within the community an irrigation system has been constructed allowing year round access to water. Many farmers from the Valle Central practice transhumant cattleholding. Due to the very dry climate, not enough forage is available for the 'criollo' cattle, which are taken between April and November to the Reserve to graze in the more abundant pastures. Migration is a dominant feature in the region with about 70% of the population migrates seasonally from the beginning of the dry season in May until October. Additionally, many households are engaged in off-farm activities. Chocloca has a high percentage of teachers, and several families have a small shop in their house.

The community has electricity, which every household has access to and most houses have running water (further away from the centre of the community, houses are still not connected to the water system). A health station is found in Chocloca, as well as a primary school and recently a secondary school has been built. There is one telephone in the village.

3.3 Land tenure conditions

The majority of the habitants of the protected area live in an unstable situation with regard to property rights and land titles. Three types of legal proprietors are present in the Reserve according to RÚA (1995):

- '*Latifundistas*', who have properties of up to 5,000 ha but live outside of the Reserve.
- '*Minifundistas*' or small proprietors who have 2 to 10 ha plots and practice agricultural activities, but are not legally registered.
- '*Asentados*', unstable landholders who have no document with respect to their holding and have simply occupied the land. Their plots are between 2 to 8 ha. These landholders dominate within the Reserve.

Amongst the pastures, more than 90% are so-called '*Pro-Indivisos*', managed as a common property with no clear borders, with the size varying between 5 to 8,000 ha. Depending on the size, there can be between four and forty users with different types of access rights (proprietors and other local user rights) (PROMETA, 2000). The biggest problem with respect to the land titles and ownership in Tariquía is the superimposition of properties, due to documents which authorise the property rights to different owners and do not have precise limits for the landholdings. It is prohibited legally to establish new settlements, only the settlements before the creation of the protected area in 1989 are admitted as being valid.

In Chocloca most households either own their land or they rent it. Furthermore they can cultivate a piece of land '*a medias*' which means that they do not have to pay rent for the land which they cultivate but which is owned by somebody else. The harvest or the profits of the sales are shared. Rent prices vary between 50 and 100 US$/ha and sales prices for the land depend on the quality, ranging between 150 US$/ha for very poor stony land, up to 2,500 US$/ha for irrigated land usable for vine.

4. Research Methodology

4.1. Selection of research communities

Two communities were selected for the study after long consideration and discussions with staff from the involved organisations MAPZA and PROMETA. Since the objective of the study is to analyse the production systems and livelihood strategies, as well as to detect the differences between the Reserve Tariquía and its influence zone, it had to be established which areas inside and outside the Reserve are related. As it has been mentioned beforehand, traditionally, during the last 150 years transhumant cattleholding has been practiced, with cattle from the zones around the protected area brought into the Reserve every year for around six months. The majority originates from the Valle Central. Usually these are left either close to the entry point in the south-west (between Sidras and Cambari, see Map 3) or in the centre of the Reserve. It was therefore decided to concentrate on communities in this area. The community of Puesto Rueda was selected because many pastures are located in its vicinity and it receives a large number of cattle according to the census conducted by PROMETA in November 1999, which monitored the number of cattle sent into the Reserve. During the interviews in Puesto Rueda the households were asked to list the communities from the Valle Central which sent most of the cattle found in their vicinity. Chocloca was amongst these. Additionally, when the census list from PROMETA was cross-checked, it was discovered that many farmers from Chocloca take their cattle to pastures close to Puesto Rueda.

4.2 Research design and data collection

4.2.1. Research design

This study has employed the *ex-post facto design*. All variables which have been investigated are natural and life experiences and can only be observed by the researcher after the fact, therefore ex-post facto. The researcher cannot apply experiments to analyse the outcome of the effect one variable has on another one, only the influence or relationship of these variables can be studied.

As it has been explained already in Chapter 2, the first two research questions are of a descriptive, as well as explorative nature. The socio-economic characteristics of the two communities' production systems and livelihood strategies are described and then followed up by exploring the differences in their performance and diversification. The third question is also explorative, as it asks about the relationship between performance and diversification. No causal relationship can be established between the two variables, apart from the performance variables, which can not all be controlled, as further extraneous variables can influence diversification.

For an ex-post research design, it is important to select randomly the sample, as it is to represent the population. Furthermore, it enables inferences to be made about the relationship between variables. The farming households within the Reserve and the

Valle Central constitute the population from which a representative sample of household units was taken. Two communities from both areas were selected. Households which are engaged in agricultural activities were chosen, which in Tariquía is fairly easy as nearly all inhabitants are farmers. A list of all families in Puesto Rueda was obtained (PROMETA, 1989a) which was updated with the help of the two authorities in the community, the leader of the rural community association (Organisación Territorial de Base, OTB), and the *Corregidor*, as well as another lady from the community, Cira Aracena. In total 24 households were identified using the household definition from the last Chapter. These were stratified into 'poor' and 'rich' farmers using local criteria, which are:

- number of cattle owned (non to very few vs. over 10 cows),
- size of land under cultivation (up to one hectare vs. over one hectare)
- age (up to 50 years old vs. over 50 yrs old)
- health status of head of household (healthy vs. sick), and
- type of dwelling, especially the roof (corrugated iron vs. bark)

According to these criteria the 24 households were divided into 8 'poor' and 16 'rich'. In total, 15 households were randomly chosen, out of which 5 were 'poor' and 10 'rich'. In the data analysis this stratification has not been used as the sub-samples were too small. The objective was to obtain data from a range of households to ensure representation of the differences in resource use and livelihoods across the wealth spectrum.

In Chocloca, farming households were selected on the criteria that they took cattle annually into the Reserve. The census list from PROMETA was used as a basis. This was updated and expanded with the help of the leader of the OTB and other farmers. 24 households were identified taking cattle every year into the Reserve, out of which 15 were randomly chosen. This selection criteria for the sample of farmers in Chocloca has been defined, as initially the impact of the transhumant cattleholding on the natural resources and production systems within the Reserve was to be investigated as well. However, as mentioned before, due to time and space limitations this issue could not be analysed. Hence, strictly speaking all results regarding the farming households in Chocloca are only representative for the subsample of farmers who are 'criollo' cattleholders in the community. Farming households who do not own these cattle possibly have a different composition of assets, maybe Holstein cattle farming will be of more importance or they have more land under cultivation. However, all 'criollo' cattleholders have mentioned the transhumant cattleholding to only be a side-enterprise. No difference regarding the socio-economic status or wealth ranking was observed between the two groups. Thus, one should bear in mind that the comparison is really only drawn between 'criollo' cattleholders within and outside of the Reserve, even if the obtained results for Chocloca are portrayed in due course to give an indication for the production systems and livelihood strategies of the entire community.

In total, a relatively small sample of 30 households have been interviewed. This was because of the time needed to prepare and conduct the interviews to obtain the necessary information from the households (see below in 4.2.2 for explanation), as well as more general logistical reasons, including the distances that had to be covered to reach the survey communities.

4.2.2. Field research instruments

A structured questionnaire was developed to obtain data on the production systems, the inputs used, quantities produced, livestock numbers etc (see Annex II). This was discussed with PROMETA staff and a pre-test conducted in Pampa Grande in Tariquía. The questionnaire was revised and the survey was carried out first in the Reserve in the months of November and December 2000. This was due to climatic conditions, as one had to walk for two days to reach the centre of the Reserve where the research station of PROMETA is located. Once the rainy season starts in December it becomes extremely difficult to enter and leave the Reserve as the rising rivers become impossible to cross. The purpose of the study was first explained to the authorities of the community and followed with two meetings to inform the farmers about the upcoming interviews. Then the households were interviewed in a random fashion, according to their time availability. In January a follow-up visit was made and some answers cross-checked. Also in Chocloca first the authorities were asked for permission and in a general meeting the purpose of the study explained to all villagers. The preparations for the survey and the survey itself were conducted in January and February 2001 and a follow up visit was made in March.

A quantitative research method has been chosen to draw statistically valid inferences regarding the entire villages. However, it proved to be very difficult always to conduct the interviews following the structure of the questionnaire. During the pre-test it became obvious that farmers were slightly suspicious regarding the questions about harvest quantities, hectares under cultivation and livestock numbers. Many feared that the data was either going to be used to introduce taxes or that the survey was conducted for PROMETA and would enable them to further restrict usages of the land or other resources. Much time had to be spent therefore with each family and several visits were necessary to explain again the purpose of the survey and gain their confidence. During some of the visits the farmer was assisted by the researcher in his daily farming tasks, for example fields were ploughed or peanuts peeled. It was through these informal talks and the willingness to participate in their activities that the farmers became more confident. Some data was obtained this way, especially on sensitive issues such as the illegal extraction of timber as well as attitudes in general towards the Reserve management or impacts of transhumant cattleholding. Thus, the quantitative survey approach has been complemented by qualitative methods with open-ended interviews and participant observation.

4.3 Analytical instruments

The data has been entered in Excel which was used for conducting the gross margin analysis. The statistical analysis has been carried out with the Statistical Package for Social Sciences (SPSS) Version 8.0.

The calculations for the gross margin involved the determination of benefit categories for crop and livestock enterprises, and the separation of variable and fixed costs. Items

which did not involve cash expenses, such as imputed interest and depreciation had to be calculated separately. Variable costs include:

- for crop enterprises four cost categories are considered: material, machinery, hired labour[4], and interest on working capital[5] (see Annex III, Table 1 for example of maize enterprise).
- for livestock enterprises, the costs categories material, hired labour, risk of loss, depreciation and imputed interest have been included (see Annex III, Table 2 for example of 'criollo' cattle enterprise).

The following fixed costs are incurred by the households in the study area and hence have been included:

- Crop production enterprises : maintenance and depreciation costs for materials and machinery, imputed interest on fixed cost items[6], as well as 5 % contingencies[7].
- Livestock farming enterprises: depreciation of infrastructure and imputed interest on fixed cost items.

Puesto Rueda is situated within a protected area where rent and land taxes are not paid. Reliable estimates are not obtainable for this area due to the difficult land tenure situation (see Chapter 3.3. for more explanation). To be able to compare both communities this cost category has been excluded.

For the first and second question univariate analysis techniques were applied. For the description of the results of the performance indicators (ratio data), the mean and standard deviation for measures of central tendency and dispersion were used. In order to test for differences and compare the means of both communities regarding their performance, the t-test has been applied. When the t-value exceeded the critical level at a significance level of up to 10% the result was accepted to show a statistical difference. For the livelihood diversification indicators (ordinal and nominal data) the mode and relative and absolute frequencies by category were used for descriptive statistics. As an inferential test the Chi-Square test has been applied testing whether differences between the communities are observed. Even though for ordinal data further analysis techniques can be carried out, such as the median or the Kolmogorov-Smirnov-Test for inferential purposes, in order to be consistent across the livelihood indicators only techniques for nominal data were employed.

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[4] hired labour means '*jornaleros*' paid on a 'task' basis and includes work for land clearing, sowing, harvesting, taking cattle to the Reserve and guarding cattle whilst on forest pastures inside the Reserve.

[5] which is calculated according to BRANDES AND ODENING (1992): Imputed Interest (Real Interest rate (i_r): 3.5%, composed of nominal interest rate (i_n): 7%, inflation rate (w_p)(INE: year 2000): 3.41%, calculation of real interest rate $i_r = (1+i_n) / (1+w_p) - 1$).

[6] According to BRANDES AND WOERMANN (1971:75) this item needs to be taken into account even if no credits are used for the purchase of fixed cost items. The money invested when using their owner's capital could otherwise be put in a savings account and gain interest.

[7] This item has been included according to BROWN (1979:19) in case miscellaneous items are overlooked. It is an arbitrary figure usually estimated to be 5 to 10% of the cost of materials and labour.

For the third research question, on the relationship between the variables performance and livelihood diversification, bivariate analysis techniques were employed. The Chi-Square test was applied to test for the differences and the contingency coefficient phi-value[8] used to assess the strength of the relationship between the two variables. This is no indication for causality and only measures the degree to which the two variables are associated. For interval and ratio data a regression analysis could be conducted to control the extraneous variables and make causal inferences or predictions.

It has to be noted, since the sample drawn was small (15 units in each community) the estimates of the population parameters become less stable and the standard error of the means increases. Small differences in population means are not as easy to detect and thus to reject the null hypothesis when it is false (BURNS 2000: 163). Therefore, the results of the statistical analysis regarding the differences and correlations between the indicators and variables have to be taken with caution. However, trends can be established and considering the results with significance levels, which are still within the 20% range of error as well as using the descriptive tools, the indications can be backed up and therefore the established null-hypotheses accepted or rejected.

[8] The phi coefficient has a minimum of 0 and a maximum of 1 and can be thought of as a correlation coefficient (BURNS, 2000: 223)

5. Results and Discussion

5.1. Production Systems

The different crop and livestock enterprises of the production systems have been investigated and evaluated with the help of the gross margin analysis. Both the descriptive results as well as the similarities and differences between both communities are displayed consequently.

5.1.1. Characteristics of crop cultivation in the research villages

A variety of crops are cultivated in both communities. However, in Chocloca additional crops are also grown for commercial purposes. The crops have been divided into four categories: 'Basic Crops', the typical crops found in this area, of which some farmers sell part of the produce; 'Cash Crops' which are mainly for sale; 'Fodder Crops', which are grown only in Chocloca as feed for the Holstein cattle; and 'Fruit from Trees', which is predominantly consumed at home. During the following discussion, only the ten crops which are cultivated in both communities are shown in the tables. However, in Table 3 all crops are shown, and in the Annex V the complete tables are displayed.

Table 3. Crops and fruit trees grown in the research communities, Puesto Rueda (PR) and Chocloca (C)

Crops found in both villages			**Crops found only in Puesto Rueda**		**Crops found only in Chocloca**	
	No. of farmers growing crop/tree			*No. of farmers*		*No. of farmers*
	PR	**C**				
Maize[a]	15	15	Yuca[a]	11	Vine[b]	6
Potatoes[a]	10	15	Soya[a]	1	Tomato[b]	7
Peanuts[b]	7	5	Wheat[a]	1	Pumpkin[b]	4
Onions[a]	12	9	Ajipa (*Pachyrhizus ahipa*)[a]	2	String beans (Chaucha)[a]	3
Peas[a]	8	9	Tobacco[a]	1	Alfalfa[c, d]	12
Sweet potato (Camote)[a]	12	1			Oats[c, d]	12
Snap beans (Poroto)[a]	13	4				
Horse beans (Haba)[a]	1	1				
Fruit trees found in both villages			**Fruit trees found only in Puesto Rueda**		**Fruit trees found only in Chocloca**	
Peaches	14	15	Lime[d]	10	Figs	15
Oranges	14	1	Mandarines[d]	8	Apple[d]	7
			Grapefruit[d]	5		
			Avocado[d]	4		

[a] Basic Crop; [b] Cash Crop; [c] Fodder Crop, [d] crop/fruit not considered in Gross Margin Analysis due to insufficient available data

Source: own survey

Two types of terrain are usually exploited for cultivation in Tariquía. All farmers use the alluvial terraces close to the dwellings in the valley along the rivers. Additionally, because such flat areas in the plains are scarce, '*desmontes*', forest plots, with an inclination of more than 50%, are developed through slash-and-burn. Generally, most farmers (86% of those interviewed) cultivate land in this way on the slopes in the '*monte*' (see picture 3, Annex I). These plots are used for two to three years, and then left to recover fertility for seven to nine years. They are located on average 30 minutes away from the houses; however one farmer walks for 1 ½ hours. This is because the '*monte*' close to the communities has already been used intensively, and if the farmers want to find virgin land, where yields are higher, they have to walk further. On average the '*monte*' plot has 1.2 hectares (ha), compared with 0.8 ha in the plains. In total, farmers cultivate around 1.9 ha. None of this land is irrigated; all depend on rain. Therefore the cropping cycle is adapted to the seasons and the availability of water. The farmers describe their land as productive and they have observed no major decline or improvement in soil fertility over the last ten years (own data). Some farmers practise mixed cropping, but in order to be able to make comparisons and for simplicity, each crop enterprise has been taken as a separate entity and the calculations and analysis conducted accordingly.

All farmers employ traditional techniques to cultivate their land and practice crop rotation to conserve the soil. On the slopes, all work is done by manual labour, and '*jornaleros*' (contract workers) are employed during the most labour intensive periods, if sufficient financial funds are available in the household. The land has to be cleared of trees and a fence constructed to keep out wild and domestic animals. These are very labour intensive tasks. In the plains, the land can be worked with bullocks which saves labour (see Annex IV, Table 1 for comparison of labour days). Very few farmers apply fertilisers, or other chemicals. All farmers make use of their own seeds if possible and exchange these at times within their community. In order to improve the seed quality or to change the variety, they also exchange with farmers from other communities in Tariquía. Hence, the variable costs are kept very low (see Annex III, Table 1 for example of calculation for maize enterprise).

In Chocloca, all farmers have their plots on even terrain, the average size is 3.2 ha. Plots are close to the houses, and average walking time is 10 minutes, although one farmer reported a distance of 45 minutes. An irrigation system was built in the 1960s, and therefore all land is watered. This allows cultivation of a variety of crops and two sowings per year of potatoes. According to the size of the area of the land under irrigation, the farmer has to provide a certain number of working hours for maintenance of the irrigation system. For each hectare of land under irrigation, he has to provide half a working day. Usually he arranges for a contract worker to carry out these tasks. Most farmers employ a large number of '*jornaleros*' during the peak times of sowing and harvesting, hence labour costs are elevated. The dairy company 'PIL' provides a tractor for their members, which can be hired. Oxen are still also employed by the farmers, to which all interviewed households have access, since they are derived from the 'criollo' cattle herd. The farmers describe their land as being fairly productive, although many have observed that an increasing amount of fertiliser input has been necessary to

achieve a good harvest over the last ten years, and that some of the terrain is 'tired' and exhausted. All farmers use chemicals, such as fertilizers, insecticides and fungicides. Where possible, seeds from their own harvest are used, or traded with farmers from other villages; although the majority nowadays buy new seeds at least once a year from the Agrochemical shops in Tarija, as it is known their yields are higher. All these factors, taken together, lead to high variable costs.

5.1.2. Comparison of performance of crop enterprises

All crop enterprises have been described and assessed with the help of the indicators, which have been explained in 2.3., according to the productive performance of the selected villages inside the Reserve 'Puesto Rueda' and outside in the Valle Central 'Chocloca'. The results are statistically analysed as to whether significant differences between the two villages can be detected. Most of the presented tables can also be found in Annex V, where additionally the standard deviations of all results are displayed.

I. Scale of farming

This indicator demonstrates the hectare size of each crop (number of trees planted) giving an indication of the scale of farming and showing the importance that the households give the crop in their farming system. As can be seen in Table 4. (and Table 1, Annex V), the scale of farming is more pronounced in Chocloca than in Puesto Rueda for all crop enterprises. For seven crops (maize, potatoes, peanuts, onions, peas, sweet potatoes and peaches), the cultivated area or the number of trees planted is larger outside the Reserve. However, be that as it may, only four of these show a significant difference. Maize occupies the largest share of the cultivated area in both communities; in Puesto Rueda 1.43 ha and in Chocloca 1.62 ha; indicating its importance within the production system in this area (see picture 4, Annex I for impression of maize plot in Chocloca). All other crops occupy less than one hectare on average; even the cash crops employ less than quarter, of a hectare, for example peanuts 0.11 ha in Puesto Rueda and 0.2 ha in Chocloca. Only the potato enterprise in Chocloca occupies more than half a hectare (0.6 ha).

II. Productivity

- Factor Productivity

The gross output (GO) of each enterprise with regard to the area it occupies is assessed with the help of this indicator. Each enterprise has been put into reference of one hectare in order to be able to draw comparisons between the enterprises, though only maize actually occupies more than one hectare in the farming system.

Across both communities the most productive crop is the ajipa (*Pachyrhizus ahipa*), a local root with a gross output per hectare of 17,200 Bs./ha (Table 1, Annex V). The seed of this crop was donated by PROMETA to a few farmers in 1999 and up until today little experience and data regarding its performance in the Reserve have been recorded. Farmers are still experimenting, and an uncertainty regarding output rates was apparent. Hence it will be excluded from any further discussion. Pumpkin,

tomatoes and grapes have very high productivity rates (12,650 Bs., 12,400Bs. and 11,838Bs. respectively per ha). They are planted mainly for commercial purposes in Chocloca, and only up to 5% of the yield is kept for home consumption. However, since these enterprises are only found in Chocloca they are also excluded from any further discussion.

Amongst the crops found in both communities, peanuts have by far the highest productivity of 3,822 Bs. in Puesto Rueda and 8,824 Bs. in Chocloca (see Table 4). Prices received for this crop are prominent in comparison with other enterprises, but farmers in Tariquía receive a lower price than in the Valle (PR ∅ 180Bs/q, C ∅ 234 Bs/q). For six crop enterprises the productivity rates are higher in Chocloca than in Puesto Rueda, especially for potato (difference of 3,223 Bs.), peanut (difference of 5,002 Bs.) and snap beans (difference of 4,425 Bs.) production. The productivity of all enterprises in Puesto Rueda is lower than the productivity in Chocloca of these enterprises. However, only four of these differences are significant at the 10% level.

- Capital Productivity

Assessing the capital productivity of the different enterprises which analyses the gross margin obtained per variable costs invested, the peanut production again obtains high results (42.48 in Puesto Rueda and 7.76 in Chocloca; Table 4 and Table 2, Annex V). Productivity is in five cases significantly higher inside the Reserve than outside, because the working capital input is at a relatively low rate in Puesto Rueda as explained above. Maize and pea enterprises in Chocloca have very low rates and the horse beans even negative ones, whereas snap beans yield the highest productivity in Chocloca of 23.05.

- Labour Productivity

This indicator is explained below, together with Labour Intensity

III. Profitability

The highest gross margin (GM) per hectare is obtained for peanuts in both communities (see Table 4; Annex V, Table 3 for details). It is higher for Chocloca (7,830 Bs./ha) compared to Puesto Rueda (3,811 Bs./ha), although the difference is not statistically significant (only at the 13% level). Five enterprises (potatoes, peanuts, snap beans, onions, and oranges) are more profitable in Chocloca than in Puesto Rueda, but only for onions is the difference significant at the 5% level. Maize, sweet potatoes, peas, horse beans and peaches are more profitable in Puesto Rueda, although only three are at the 1% level significant. Thus, profitability of the crop enterprises is not necessarily higher outside of the Reserve than inside.

Table 4. Scale of farming, Factor and Capital Productivity, Profitability, Capital Efficiency of selected crop enterprises in PR and C

Crop enterprise			Hectare size (ha)			Productivity (GO/ha; in Bs.)			Capital Productivity (GM/VC)			Profitability (GM/ha; in Bs.)			Capital Efficiency (VC/GO, in %)		
	PR	C	PR	C	t-test	PR	C	t-test	PR	C	t-test	PR	C	t-test	PR	C	t-test
	N	**N**	**Mean**	**Mean**	**t**	**Mean**	**Mean**	**t**	**Mean**	**Mean**	**t**	**Mean**	**Mean**	**t**	**Mean**	**Mean**	**t**
Maize	15	15	**1.43**	**1.62**	-0.682	1,645	1,035	2.930**	2.94	0.39	5.676***	1,239	254	5.091***	25	**89**	-5.362***
Potato	10	15	0.17	0.60	-4.096***	1,320	4,543	-3.702***	3.56	1.01	2.973***	1,072	2,096	-1.232	14	68	-4.076***
Peanuts	7	5	0.11	0.20	-2.043*	**3,822**	**8,824**	-1.976*	**42.48**	**7.76**	6.479***	**3,811**	**7,830**	-1.627	0	15	-4.272***
Onions	12	9	0.06	0.22	-2.573**	590	2,618	-4.827***	3.03	1.49	1.295	536	1,459	-2.129**	7	69	-3.695***
Peas	8	9	0.04	0.28	-2.280**	2,843	1,566	1.867*	22.19	0.38	9.928***	2,804	507	4.041***	1	**256**	-1.299
Sweet potato	4	1	0.06	0.13	-1.291	1,854	960	0.307		6.73		1,854	836	0.349	0	13	0
Snap beans	2	4	0.31	0.22	0.516	2,090	6,515	-2.179*		**23.05**		2,090	5,915	-1.808	0	11	-2.167*
Horse beans	1	1	0.02	0.25	0	10	80	0		-0.61		10	-123	.	0	**254**	0
Peaches	14	15	12[a]	37[a]	-1.578	12	11	1.447		2.00		12	6	4.988***	0	40	-4.917***
Oranges	14	1	16[a]	2[a]	0.492	10	16	0				10	16	0	0	0	.

*** significant at 1% level, ** significant at 5% level, * significant at 10% level [a] no of trees planted; Enterprises with highest values are printed in bold

Source: own survey

Table 5. Labour Intensity and Productivity of crop enterprises in PR and C

			Total Labour Input per ha (persondays)			Productivity of labour (GM/personday; in Bs.)		
	PR	C	PR	C	t-test	PR	C	t-test
	N	**N**	**Mean**	**Mean**	**t**	**Mean**	**Mean**	**t**
Maize	15	15	69	24	13.944***	18	10	1.650 (11%)
Potato	10	15	85	**58**	4.564***	13	82	-1.871*
Peanuts	7	5	**129**	56	2.112*	**33**	**135**	-2.645**

*** significant at 1% level, ** significant at 5% level, * significant at 10% level;

Enterprises with highest values are printed in bold

Source: own survey

IV. Resource usage in farming

- Capital Efficiency

Variable costs are an important factor in determining the gross margin, indicating the requirements for working capital. For example, in the case of the horse bean cultivation in Chocloca, because of very high variable costs, the gross margin turns negative, making it an unprofitable enterprise. The ratio of variable costs per gross output indicates the capital efficiency within the farming production. For all enterprises, the costs per gross output are higher in Chocloca than in Puesto Rueda, although only six show a significant difference (see Table 4; and Table 2, Annex VI). In the pea and horse bean production outside the Reserve the incurred variable costs are even higher than the benefits. Maize production in Chocloca is very capital efficient, the production of a value of 100 Bs. produces on average costs of 90 Bs., made up mainly of hired labour and machinery costs.

- Total Labour Intensity and Productivity

Because farmers have small areas for each crop under cultivation, they found it very difficult to memorise the number of hours spent working on each enterprise. Therefore, during the investigation, data was collected only on the three main crops: maize, potatoes and peanuts (see Table 5). The data obtained has to be viewed with some caution, as most farmers made rough estimates of the amount of time spent on these crops. However, an indication is given regarding the intensity and profitability of labour for these enterprises and the differences between the two communities.

The labour absorbing capacity in Puesto Rueda is significantly higher for all three enterprises, especially for maize production (129 persondays per ha in Puesto Rueda vs. 56 in Chocloca). This can be attributed to the fact that maize is usually farmed on the slopes where labour input is high, because for the plot to be usable for agricultural production, various labour-intensive tasks need to be fulfilled. Only few farmers cultivate maize on the plains where oxen can be used to work the soil. In Chocloca nearly all farmers (86%) rent a tractor, which decreases the manual labour input.

Labour productivity is highest for peanut production in Chocloca, due to the very high price it earns in the market in comparison to potatoes and maize. The average agricultural labour wage rate in Tariquía lies between 15-20 Bs./day. Hence, maize production with 18 Bs./day is just about profitable, whereas the returns of peanut production allow an extra margin of 13 Bs./day. In Chocloca, the labour productivity of potato and peanut production is very high (82 and 135 Bs. respectively), and returns in comparison to the agricultural labour wage rate (25Bs./day) are considerably superior. Returns in Puesto Rueda are much lower with 13 and 33 Bs./day for the potato and peanut production. Only for maize production, does the gross margin per personday of labour input not reach the wage rate.

5.1.3. Characteristics of livestock enterprises in the research villages

In the study area, it is common for the households to keep a combination of different livestock species, and most of these are present in both villages. However, 'Holstein' milk cows and goats are only present in the Valle Central and the combination of animals held is different, as seen in Figure 2.

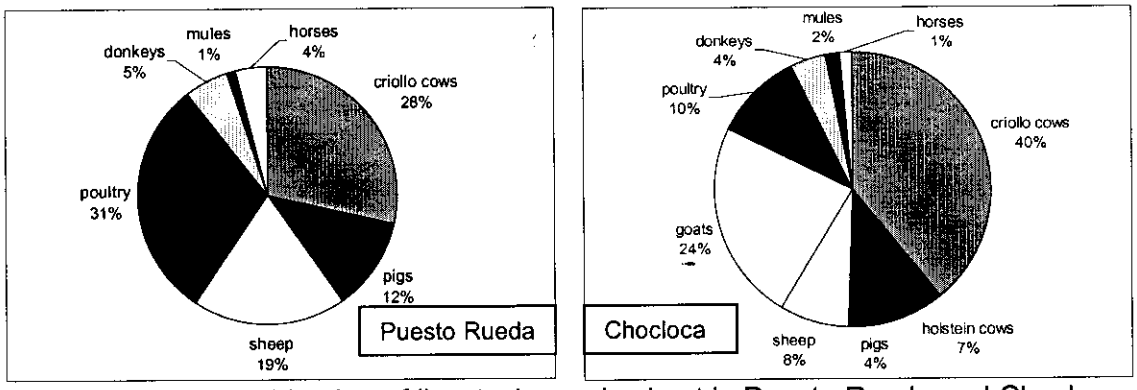

Fig. 2. Average combination of livestock species kept in Puesto Rueda and Chocloca
Source: own survey

Inside the Reserve poultry and 'criollo' cows are the dominant species, followed by sheep and pigs. In Chocloca the 'criollo' cattle are the dominant livestock, followed by goats. Poultry, pigs and sheep are less represented, due to the fact that Chocloca is becoming more urbanised and many families for hygienic reasons do not want to keep livestock close to their houses. The Holstein cows are gaining importance in their production systems as discussed below. The species have been divided into five groups according to the functions they fulfil: 'Large Home' (cattle) and 'Small Home' animals (pigs, sheep, goats, poultry), 'Cash Animals' (Holstein cattle), 'Draught Animals' (oxen) and 'Transport Animals' (horses, donkeys, mules). For the following analysis only cattle, pigs, sheep, goats and poultry have been considered, whereas horses, mules and donkeys are included again in the livelihood diversification analysis. (see picture 5, Annex I for impression of diversity of livestock kept in Puesto Rueda.)

'Criollo' cattleholding exists in both villages and is an important part of the production system of the households. Cattle are not so much seen as a productive resource, but fulfil the economic function of a moneybox (*'caja de ahorro'*). In case of an emergency they can be sold very quickly and provide a financial back-up. Especially within Tariquía, the number of cattle held serves as a criteria for socio-economic stratification amongst the villagers. Cattle are either left on pastures surrounding the community all year round, or during winter, when forage is in short supply, are taken to huge pastures, up to two days walk away. These are the *'Pro-Indiviso'* pastures which are managed as a common property. They are also used by the farmers from the Valle Central, who during the dry season bring their transhumant cattle to the Reserve. It is estimated that approximately 25,000 cattle originating from the surrounding areas of the Reserve are left for six months of the year on these forest pastures. In the Reserve around 7,000 cattle are kept by the local population (F. CHAVEZ, pers. comm.).

Farmers' opinions in Chocloca regarding the 'criollo' cattle are divided; some households have mentioned it to be not a very profitable enterprise, causing a heavy workload. Others regard them as an important saving, allowing them to get cash quickly in bad times. Especially amongst young people, the desire to do away with the transhumant cattleholding is prevalent, as new types of jobs outside agriculture are seen to be far more attractive, as they are less labour-intensive and better paid.

Products derived from these cattle are usually consumed at home; on average two cows per year are slaughtered in Puesto Rueda and three in Chocloca. Sales are low; on average in the Reserve one cow will be sold annually for an average price of 1,000 Bs., whereas in Chocloca three will be sold for 1,400 Bs. on average. The milk production in this extensive system is reduced, due to a very low average daily milk rate (1 litre). Cows are rarely milked as people are not used to drink it. Often they are on forest pastures which are too far away for daily milking and even if they are in the vicinity of the houses they are often not kept in corrals. Hence the milking period can only be accounted as four months per year. The calving interval is not very high, about every two years. Variable costs for the 'criollo' cattle are low and only include veterinary expenses and salt, and the non-cash expenses such as the risk of loss, depreciation and imputed interest. Farmers from Chocloca also hire '*jornaleros*' when they take their cattle back and forth to Tariquía, which takes each way about six days. Additionally, somebody is usually paid to guard their herd whilst they are on the forest pastures (see Annex III, Table 2 for calculation of gross output and cost categories for 'criollo' cattle enterprise).

About seven years ago Holstein cattle were introduced in many villages in the Valle Central, and today in Chocloca 56 households possess at least one or two Holstein cows (see picture 6, Annex III for impression of Holstein cattle farming in Chocloca). They were used to provide an alternative income source after vines, which used to be the traditional cash crop in the region, were removed by many farmers after a heavy hailstorm in 1980. The milk is bought by the local dairy company 'PIL', which has built two collection points in the village, from where it collects and transports the milk once a day to Tarija. Although many farmers feel that the Holstein cows cause a lot of daily work (cutting fodder, milking) and high costs (vaccinations, medicines etc) it provides them with a constant stream of income. Benefits are derived from the occasional sale of a heifer or bull calf (800 Bs. on average) and the milk production. The daily milk yield varies between 8 and 16 litres and is sold at a price of 1.50 Bs. per litre to the 'PIL'. The milking period is about 8.5 months and the calving interval 1 ¼ years. Prices for Holstein cows vary between 700US$ and 1000US$. Costs are much higher for these cows compared to the 'criollo' cattle, as apart from the same expenditures such as veterinary items, salt, depreciation etc., extra feed needs to be bought and '*jornaleros*' employed to cut fodder and help look after the cows.

All other livestock species are low-input enterprises, and costs are insignificant. Pigs are rarely sold (only 2 households in Puesto Rueda and 1 household in Chocloca reported sales), but rather consumed at home (about 2 per year). Sometimes they are slaughtered and the meat is sold separately. Additionally, butter is obtained from the

pigs, which is used for cooking and baking. Costs are kept low; they are fed with maize and other crop residues, as well as waste. Very little veterinary expenses are incurred, and only risk of loss, depreciation and imputed interest have to be accounted for. Sheep are never sold but rather slaughtered for home consumption (Puesto Rueda: ∅ 2 per year; Chocloca: ∅ 4 per year). All households use the wool at home; sometimes some part of it is sold. Again costs are only incurred for veterinary expenses, as well as for the risk of loss, depreciation and imputed interest. The same cost categories are found for goats and poultry. Goats are mainly consumed at home and rarely sold. All small animals have a savings functionin bad times, as an animal can be eaten, and they are simply kept on the pastures surrounding the village at little cost. Especially in Tariquía, poultry is kept by all farmers. It provides the main meat source for the households, which is a well appreciated item in their diet. Many farmers derive a small income from the sales of these, but also exchange them for crop products with people from other communities. In Chocloca chickens are only kept for home consumption and are found in smaller numbers.

5.1.4. Comparison of performance of livestock enterprises

Similar as for the crop enterprises, the results of the analysis regarding the production performance of the livestock enterprises are shown using a variety of indicators and then a comparison between the two communities drawn up.

I. Scale of farming

The herd sizes of the six species of interest have been analysed, and consequently the importance of each enterprise has been assessed with regard to its scale of farming (Table 6 and Table 3, Annex V).

Table 6. Scale of farming – livestock numbers kept by households

	PR	C	PR	C	T-Test
	N	**N**	**Mean**	**Mean**	**t**
Criollo cattle	12	15	**24.4**	**37.6**	-1.701
Holstein cattle	0	11		6.6	
Pigs	11	11	10.2	4.2	2.651**
Sheep	12	5	16.3	7.6	1.920*
Goats	0	4		22.8	
Poultry	15	13	**25.9**	10.0	4.222***

*** significant at 1% level, ** significant at 5% level, * significant at 10% level
Enterprises with highest values are printed in bold
Source: own survey

Not all farmers within the Reserve have 'criollo' cattle, in the present sample only twelve households keep them. In both communities eleven households have pigs; twelve households in Puesto Rueda keep sheep, whereas in Chocloca only five farm these. Goats and Holstein cattle are only kept in Chocloca, only four households farm goats, but eleven have Holstein cattle. The average size of the 'criollo' cattle herd in Chocloca amounts to 40 cows, whereas in Puesto Rueda they are only half that number (no statistical difference, but at significance level of 10.1% different). On

average ten pigs are kept in Puesto Rueda, 16 sheep and 26 chicken; numbers in Chocloca are lower, respectively four, eight and twelve animals are kept.

This shows the size of livestock farming, with regard to large and cash animals, to be greater outside, and of small animals to be significantly greater inside the Reserve. In Tariquía all households keep a high number of poultry as they always provides a source of meat and eggs.

II. Productivity

- Factor productivity

As can be seen in Table 7. (and Table 4, Annex V), the gross output of 2,293 Bs. per animal is extremely high for the Holstein cattle, due to their constant milk production. Amongst the enterprises, which are present in both communities, the pigs have the highest productivity, which holds true for both villages (230 Bs. in Chocloca and 137 Bs. per animal in Puesto Rueda). Statistically seen, productivity is not higher in Chocloca, though, at a significance level of 11%, it can still be accepted as being relevant. For the 'criollo' cattle and sheep enterprises, higher productivity rates are obtained outside of the Reserve; for the 'criollo' cattle only at the 12% level a significant difference is detected, whereas for sheep this holds true already at the 5% level. It can be summed up that, productivity of livestock enterprises is higher outside of the Reserve than inside.

Table 7. Productivity of livestock enterprises

			Factor Productivity (GO/animal; in Bs.)			**Capital Productivity (GM/FC; in %)**		
	PR	C	PR	C	T-test	PR	C	T-test
	N	**N**	**Mean**	**Mean**	**t**	**Mean**	**Mean**	**t**
Criollo cattle	12	15	98	177	-2.056**	-2	9	-1.591
Holstein cattle	0	11		2,293			19	
Pigs	11	11	**137**	**230**	-1.640	**94**	**128**	-0.759
Sheep	12	5	12	45	-3.456***	13	67	-2.530**
Goats	0	4		13			2	
Poultry	15	13	55	42	0.940	**257**	**259**	-0.029

*** significant at 1% level, ** significant at 5% level, * significant at 10% level
Enterprises with highest values are printed in bold
Source: own survey

- Capital productivity

Interestingly for livestock enterprises is also the capital productivity indicator. It shows the return per unit of the fixed capital invested in the enterprise. The fixed capital is mainly represented by the herd itself, and only a small part embodies the value of the infrastructure, as this only consists of corrals and stables. Poultry is a very attractive enterprise, the fixed capital requirements being extremely low with regard to its profitability; they score a 260% return rate in both villages (Table 7). The same holds true for the pig enterprise. The amount obtained when a household sells its entire stock of animals and deposits the money in a savings account, with a real interest rate of

3.5%[9], represents the opportunity cost of the fixed capital. Currently the returns of the 'criollo' cattle enterprise in Puesto Rueda are negative. Hence the households in Puesto Rueda could, if they sold their cattle rather than keeping and maintaining them, obtain a higher return by depositing this money. The same holds true for the goat enterprise in Chocloca.

Capital productivity rates are higher in Chocloca, although statistically seen this only holds true for the sheep enterprise. For the 'criollo' cattle enterprise, considering the fact that in Puesto Rueda a negative productivity (-2%) is obtained, whereas in Chocloca it is positive (9%), and testing for the statistical difference, a significance level of only 12% is reached. Therefore, it is concluded, that an enterprise outside the Reserve scores a higher productivity.

III. Profitability

The Holstein cattle enterprises, even though incurring very high variable costs , for reasons explained above, not only have the highest productivity but also the highest profitability rates, as can be seen in Table 8 and Table 4, Annex V. Meanwhile pigs, as an enterprise present in both villages, obtain for both communities the highest gross margin per animal of 22 Bs. in Chocloca and 129 Bs. per animal in Puesto Rueda. The sheep enterprise is considerably more profitable outside the Reserve than inside. Although statistically, for cattle the profitability rates are not higher in Chocloca in comparison with Tariquía (significance level of 14%). For pigs (significance level of 12%), due to the relatively low significance levels, and regarding the fact that sample sizes are small, it is therefore concluded that profitability rates for livestock farming are higher in Chocloca.

Table 8. Profitability and Capital Efficiency of Livestock enterprises

			Profitability (GM/animal; in Bs.)			**Capital Efficiency (GO/VC; in %)**		
	PR	C	PR	C	T-test	PR	C	T-test
	N	**N**	**Mean**	**Mean**	**t**	**Mean**	**Mean**	**t**
Criollo cattle	12	15	-15	82	-1.495	**8**	**38**	-2.400**
Holstein cattle	0	11		810			62	
Pigs	11	11	**129**	**220**	-1.628	1	1	-0.176
Sheep	12	5	6	38	-3.186***	2	2	-0.074
Goats	0	4		2			3	
Poultry	15	13	51	39	0.943	0	0	0.116

*** significant at 1% level, ** significant at 5% level, * significant at 10% level
Enterprises with highest values are printed in bold
Source: own survey

IV. Resource usage in farming

- Capital Efficiency

As compared to crop enterprise activities, the livestock farming systems can be characterised as being extensive with regard to the incurred variable costs (see Table

[9]See Chapter 4.3. for calculation of real interest rate

4 and 8 for comparison). Working capital requirements are much lower, and therefore, when they are put in relation to gross output, the capital efficiency indicator is between 1 and 3% (8% for the 'criollo' cattle in Puesto Rueda); apart from the Holstein (62%) and 'criollo' cattle (38%) enterprises in Chocloca. The small animal enterprises in particular have very few working capital requirements. This only holds true, if items which involve no cash expense for the household, are not taken into account.[10] The 'criollo' cattle enterprise is more capital efficient, due to high costs for hired labour in Chocloca (taking cattle back and forth and guarding them whilst in the Reserve), and the veterinary costs, incurred by all farmers.
Capital efficiency is higher in Chocloca, although statistically this difference is only significant for the 'criollo' cattle enterprise.

5.1.5. Comparison of performance of the farm as a whole

The final analysis is undertaken for the complete crop and livestock farming enterprises, as well as those for the whole farm, and a comparison will be drawn between the two communities inside and outside of the Reserve. The indicators are similar to those already discussed in the previous sections. This time the productivity and profitability indicators are calculated as total numbers and not on the basis of hectare size or animal numbers, as numbers across all enterprises have been added up.

I. Scale of farming

The total area under cultivation is significantly larger (3.2 ha in Chocloca and 1.9 ha in Puesto Rueda) and households keep a higher number of livestock species outside the Reserve (not statistically, but at a significance level of 11%, the difference can be accepted), as can be seen in Table 9 and Table 6, Annex V. Besides, looking at the total number of animals (adding up all animals held in Tropical Livestock Units (TLU[11])), households in Chocloca have significantly more livestock: 40 TLUs are kept in comparison with 20 in Puesto Rueda.

Table 9. Scale of farming – Total numbers

	PR	C	T-Test
	Mean (n=15)	**Mean** (n=15)	**t**
Total cultivated area (ha)	1.9	**3.2**	-3.306***
No of different livestock species	3.3	3.9	-1.635
Total no of animals (in TLU)	18.8	**37.8**	-2.982 ***

*** significant at 1% level, ** significant at 5% level, * significant at 10% level
Higher values are printed in bold
Source: own survey

[10]Based on BIRNER (1996:328) separate capital efficiency indicators have been calculated. Items without cash expenses include material and hired labour expenses. See Annex V, Table 5 for comparison of indicator inclusive all items.
[11] See Annex IV, Table 2 for explanation

II. Productivity

Productivity is higher for the livestock sector than for the crop sector in both communities (Table 10 and Table 7, Annex V). This can be attributed to the fact that within the livestock sector the output rates are higher (In the livestock sector the gross output is on average 2,000Bs. per enterprise, and in the crop sector 600Bs. per enterprise (on a basis of absolute GO data)).

Following the tendency of the results of the previous sections, one can already presume productivity rates to be higher outside of the Reserve in comparison to inside. This holds true for the total crop (12,179 Bs. and 3,458 Bs. respectively) and total livestock (19,174 Bs. and 4,275 Bs. respectively) sector, as well as for the whole farm (31,352 Bs. and 7,733 Bs.); all mean results are statistically significantly higher in Chocloca.

Table 10. Total Productivity, Profitability and Capital Efficiency

	Productivity (Bs.)			**Profitability (Bs.)**			**Capital Efficiency (%)**		
	PR	C	T-test	PR	C	T-test	PR	C	T-test
	Mean (n=15)	**Mean** (n=15)	**t**	**Mean** (n=15)	**Mean** (n=15)	**t**	**Mean** (n=15)	**Mean** (n=15)	**t**
Crops	3,458	12,179	-4.355***	2,848	7,415	-2.791***	17	48	-4.049***
Livestock	4,275	19,174	-5.270***	2,489	8,510	-2.691**	42	62	-1.714*
Total	7,733	31,352	-5.988***	5,336	15,925	-3.257***	28	54	-3.823***

*** significant at 1% level, ** significant at 5% level, * significant at 10% level
Enterprises with highest values are printed in bold
Source: own survey

III. Profitability

- Total Profitability

Even though the total variable costs incurred in Chocloca are significantly higher (in Puesto Rueda: 2.397 Bs.; in Chocloca: 15.428 Bs.; Table 7, Annex V), profitability is significantly lower in Puesto Rueda (Table 10). Again this can be observed for both the crop, as well as the livestock sectors. Total profitability in Puesto Rueda (5,336 Bs.) is only one third of the profitability rate outside of the Reserve (15,925 Bs.).

- Total Farm Profitability

The Net Farm Income, as the principal measure of the year-by-year profitability of the farm as a whole has been calculated, and results are illustrated in Table 11 and Table 7, Annex V. In Chocloca the net farm income of 15,000 Bs. is two thirds higher compared to Puesto Rueda (5,000 Bs.).

Table 11. Total Farm Profitability and Land Use Productivity

	PR	C	T-test
	Mean (n=15)	**Mean** (n=15)	**t**
Total Net Farm Income (Bs.)	**5,115**	**15,040**	**-3.064*** **
Total Net Farm Income US$ (per month)	**812 (68)**	**2,387 (199)**	**-3.064*** **
Net Farm Income / ha of total farm land (Bs.)	**2,814**	**4,841**	**-2.100** **

*** significant at 1% level, ** significant at 5% level, * significant at 10% level
Enterprises with highest values are printed in bold
Source: own survey

IV. Resource usage in farming

- Capital Efficiency

Working capital requirements are significantly higher in Chocloca in comparison with Puesto Rueda. As can be seen in Table 10 (and Table 9, Annex V), about 50% of the gross output is used for working capital requirements in Chocloca, whereas in Puesto Rueda less capital is used within the farming sector, and the efficiency is half that of Chocloca's.

- Land Use Productivity

The net farm income per hectare of total farm land gives an indication regarding the productivity of land use (Table 11; Table 9 in Annex V). It is significantly higher outside of the Reserve by nearly 50% (4,841 Bs. in Chocloca vs. 2,814 Bs. in Puesto Rueda).

5.1.6. Summary and Discussion

To summarise the results of the previous sections, for the first variable 'Scale of farming' amongst the crop enterprises the extent of farming is larger in Chocloca, and numbers are in most cases significantly higher. For the livestock enterprises only the herd sizes of the large animals are greater in Chocloca, whereas the small animal herd sizes are larger in Puesto Rueda. The factor productivity again for most enterprises, both crop and livestock, is lower in Puesto Rueda, whereas capital productivity is lower in Chocloca due to a higher working capital usage. Labour productivity, which could only be calculated for certain crop enterprises, is higher in Chocloca, and returns in comparison to the average wage rate in agriculture are superior. No significant differences are observed for the profitability rates within the crop sector between the two communities, whereas in the livestock farming sector the gross margin obtained per animal is more pronounced outside of the Reserve. The 'Resource usage in farming' variable shows the production in Chocloca to be more capital efficient within the livestock sector and especially so within the crop sector.

In order to draw a comparison between the two villages regarding their production performance, only specific indicators have been selected for each working variable, and the results of the analysis of the comparison of the farm as a whole (Section 5.1.5.) are used to obtain a ranking. The ranks for each indicator have been calculated by using the range of results of all households and dividing it into three equal groups, thus each group has an equal weight (for the conversion of the results into rank groups see

Table 1, Annex VI). Each rank corresponds to a performance category (low, middle and high) and all results of every household have been assigned to one of these. The Chi-Square test has been applied to obtain the frequency distribution for each category (see Table 2, Annex VI for percentages), as well as the Chi-Square value and significance levels to assess the difference between the communities. The following Table 12 shows for every indicator into which category each village falls, according to the central tendency (mode). In the last column it is displayed which community can be seen to have a statistically significant higher performance.

Table 12. Production Performance Categories

Variable	Indicator	Performance Category			Higher statistical performance[a]
		Low	Middle	High	
1. Scale of farming	**Total ha**	PR	C		C **
	Total TLU	PR	C		C **
2. Productivity	**Total GO**	PR	C		C ***
3. Profitability	**Total GM**	PR / C			C **
	Net Farm Income	PR / C			C **
4. Resource usage in farming	**GO/VC**	PR		C	C ***
	NFY/ha	PR / C			C *

*** significant at 1% level, ** significant at 5% level, * significant at 10% level

[a] The community with the higher performance value is shown

Source: own survey

For all indicators Chocloca has a higher production performance. Therefore the first Null-hypothesis, that there will be no significant difference between the productive performance of the farming systems of the communities within the National Reserve compared to the communities in the Valle Central, is rejected.

For the analysis of the production systems mainly economic indicators, measuring the performance of the system have been used. It has been assumed that higher results, regardless of whether they are concerned with the size of farming, or whether they measure productivity indicators or working capital requirements, indicate a high productive performance. Obviously this is a very simplified vision, and it is not necessarily an indicator of the appropriate, sustainable or efficient usage of input and production factors, nor whether output rates are constant over time. The impact on the environment has not been assessed, as for example, an elevated usage of certain working capital, such as agro-chemicals, certainly will have repercussions on the crop, the soil fertility and productivity, and the human being at the end of the food chain. It has not been the aim of this analysis to include these considerations, and even though they are very important, it would surpass the capacity of this study. Nevertheless, many results have been obtained regarding the productive performance of the farming systems and its enterprises in the study area.

Amongst the crop enterprises, maize production takes a very important place in both villages. Many farmers mentioned in the interviews that they do not perceive their maize production as being profitable, due to the high incurred costs. It does not appear to have a particularly high output, and the working capital requirements and the labour intensity, especially in Puesto Rueda are very high. Notwithstanding, it occupies by far the largest area within the farming system and is an essential part of it, because it is used for both human consumption and as feed for all livestock species. This makes the households adhere to its production. Looking at the different productivity and profitability indicators, peanut production is very interesting from the economic point of view, as it scores the highest rates and has a very high return for its labour input. Its production occupies a small share of land within the farming system, but only about half of the interviewed households actually cultivate this crop.

Amongst the livestock enterprises, the Holstein cattle appear to have very high productivity and profitability rates. Notwithstanding, they have very high working capital requirements, hence the up-keep of these cows is quite cost intensive. They would not be of interest for households in Tariquía however, as the milk could not be sold commercially. The pig enterprise obtains very good results within both villages, and should be seen as an option for improving the farming system from an economic point of view. The 'criollo' cattle enterprise, especially in Puesto Rueda is not at all profitable. As has been mentioned, due to their low capital productivity, households would gain financially if they sold their herd and deposited the money in a bank. However, this is a very theoretical point of view, as the cattle not only represent a financial asset, but also long-term insurance for the household and in bad times a cow can be quickly sold to obtain money. Additionally the fact of owning cattle and the size of the herd represents a social status within the community, especially within Tariquía.

Assessment of the capital efficiency indicator leads to the conclusion that working capital requirements are higher outside the Reserve compared to inside. Several factors have to be considered. Expenditures for working capital are higher in Chocloca, because farmers in Tariquía have little financial capital and hardly any access to credit. They operate low-input systems, still employ traditional technologies and have no possibility of mechanising their system due to the lack of a road. Additionally, they hardly have any access to chemical products such as fertilisers; the Park Management tries to prohibit the use of these materials[12]. In the livestock farming sector access, but also knowledge regarding the use of vaccinations and medications, is limited in Tariquía. The standard vaccines are given to the cattle (foot-and-mouth disease, rabies, symptomatic anthrax) and sometimes to other animals; however, further treatment is difficult to get hold of and often not known about.

Regarding the net farm income obtained in the two communities, several issues have to be dealt with. The average monthly income for a more or less qualified worker in Tarija is about 200-300 US$ (I. ARNOLD, pers. comm.). Hence the agricultural income of 200 US$ obtained in Chocloca lies at the bottom of this income range and is not

[12] Due to its protected area status, agro-chemicals should not be used. This is not a law, but PROMETA tries to enforce it as an institutional policy. (G. SALINAS, pers. comm.).

entirely competitive with the salary earned in other jobs. In Puesto Rueda, income is very low, at 68 US$ per month (see Table 11). Nevertheless, farmers who are currently working their land in Chocloca would not easily be able to give up their land and move into other employment, because of high opportunity costs. They own their land and livestock, from which they derive a steady stream of income allowing them to survive and live, whereas looking for new employment and moving to a big city would involve considerable costs. It has been observed that many farmers now have a secondary occupation; they run a small shop, drive a bus, are teachers, sell meat or work on the agricultural research station in the village. Among young people an outward migration can be observed. Out of all interviewed households ten have on average 2.2 members migrating. The main reason cited was education. In Tariquía, migration is very common, and although not many young people are sent away for education, the majority of young people look for work outside of the Reserve. It is common for the head of the household or other members to migrate on a temporary basis, working as labourers on farms or construction sites, and young women as domestic servants. Thirteen households out of all interviews have on average 1.9 members migrating. Between 1,500 and 2,800 Bs (240-440 US$, own survey) can be earned on average per year with these kinds of jobs. In the best cases this raises the monthly net farm income to 100 US$, which is still below the average income rate for workers in Tarija.

5.2. Diversification of Livelihood Strategies

In the first part of this chapter several references have already been made concerning the issue of diversification of the activities of the farmers. In general farming households do not just concentrate on farming, but undertake a variety of different activities that diversify their livelihood system. The important concept is **'livelihood'**, which has been defined in Chapter 2 as 'the ways in which people satisfy their needs or gain a living' (CHAMBERS AND CONWAY, 1992:6). This diversification can be observed in most societies within their livelihood systems; usually it is linked to increasing the chances of survival, in order to sustain a living in a fragile production environment. Small-scale producers and poor households are particularly risk-prone and within the diversification seek a way of countering events such as environmental hazards, financial insecurity and internal household problems.

Three pathways of livelihood diversification were identified: the diversification on-farm, the diversification of the livelihood encompassing non-agricultural activities and migration. Each dynamic constitutes a working variable and will be discussed in turn.

5.2.1. On-farm diversification

The characteristics of the crop production and livestock farming systems of both communities have been described in detail in 5.1.; now the level of on-farm diversification will be assessed. Four indicators have been selected in order to identify the degree of diversification, as well as the differences between the communities inside and outside of the Reserve.

I. Crop Diversification Indicator I – Plant composition

With the first indicator the number of different crops which are cultivated within the two communities is evaluated. In total, 27 different crops and trees have been identified (see Table 3). The interviewed farmers grow a minimum of 5 crops/trees and a maximum of 16. A ranking has been undertaken, and three categories formed (see Annex VI, Table 3 for conversion into categories). Consequently both communities have been appraised regarding the number of cases within each category and with the Chi-Square test it has been analysed whether a significant difference exists between the two communities.

Table 13. Frequency distribution of Crop and Livestock Diversification Indicators

Diversification category	Diversification Indicator Crops (%)		Diversification Indicator Livestock (%)	
	PR (N=15)	C (N=15)	PR (N=15)	C (N=15)
Low	20	40	33	7
Middle	67	47	60	80
High	13	13	7	13

Source: own survey

The mode for the indicator for both villages shows a middle diversification (Table 13 for percentages of cross-tab output) which is graphically shown in Figure 3. Comparing the diversification indicator of the crop composition in both villages, no statistical difference can be observed (Chi-Square value: 1.529 => not significant). Additionally, the total number of crops cultivated in both villages has been analysed; on average in Puesto Rueda 9.9 different crops are cultivated, and in Chocloca 9.4 crops. A t-test has been conducted in order to detect a difference, but it shows no significant contrast.

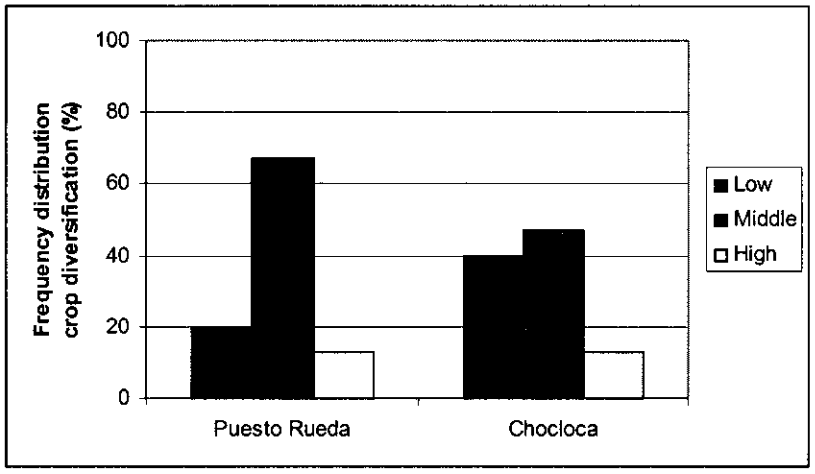

Fig. 3. Frequency Distribution of Crop Diversification Categories
Source: own survey

II. Crop Diversification Indicator II – Function categories

Furthermore the functions of these crops have been taken as the basis for comparison. The crops are cultivated for different purposes, and depending on the spread of crops amongst these functions, it can be assessed whether the farmers try to diversify their output. As already explained in 5.1.1., the crops and trees have been divided into four

different categories according to their functions, (see Table 3): 'Basic Crops' (BC), 'Cash Crops' (CC), 'Fodder Crops' (FC) and 'Fruit Trees' (FT). Four different combinations of these groups have been identified which are cultivated amongst the interviewed households. Consequently these combinations have been ranked and were assigned to the same diversification categories as used above (Table 4, Annex VI for conversion into categories). Again it has been analysed to which categories the two communities belong and, using the Chi-Square test, whether any disparity can be observed.

Table 14. Frequency distribution of Crop and Livestock Function Diversification Indicators

Diversification category	Diversification Indicator Function of Crops (%)		Diversification Indicator Function of Livestock (%)	
	PR (N=15)	C (N=15)	PR (N=15)	C (N=15)
Low	53	13	33	0
Middle	47	20	67	47
High	0	67	0	53

Source: own survey

As seen from the cross-tab results in Table 14, and the central tendency of the distribution, there is a low diversification (53%) inside the Reserve and a high one (67%) outside. A significant difference between the two communities exists (Chi-Square value: 15.20 => significant at 1% level), showing the diversification to be higher outside of the Reserve regarding the functions of the crops. This is supported by looking at the composition of crops, for each of these function groups in both villages (see Figure 4). A relatively more even distribution of all four function groups is apparent in Chocloca, whereas in Puesto Rueda 58% of the cultivated crops belong to the basic crop group.

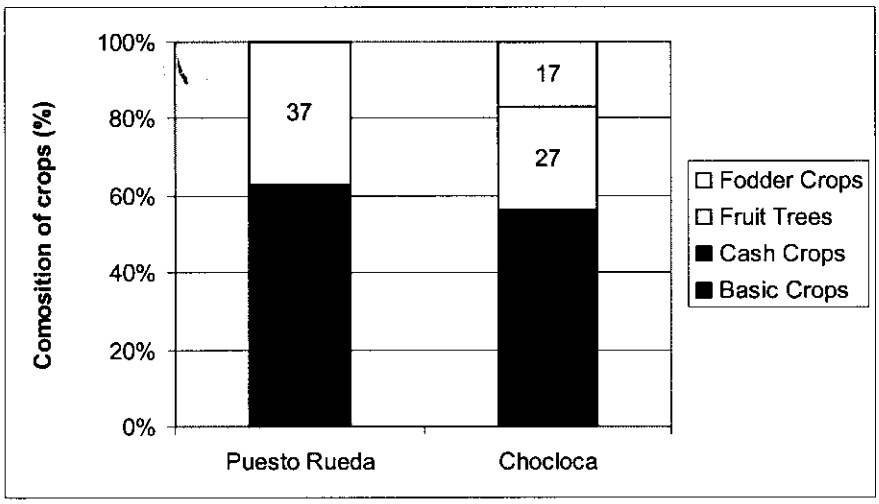

Fig. 4. Composition of crops cultivated according to their functions
Source: own survey

III. Livestock Diversification Indicator I – Species Composition

The number of different livestock species held by the farmers is the next diversification indicator. Hence, the variety of species owned will be assessed, as well as the difference between both villages. The procedure for the construction of the livestock indicator is similar to the crop indicator. Nine different species (as described in 5.1.3.) are kept by farmers in this area. The species have been ranked into groups and consequently assigned to the diversification categories (Table 3, Annex VI for conversion into categories).

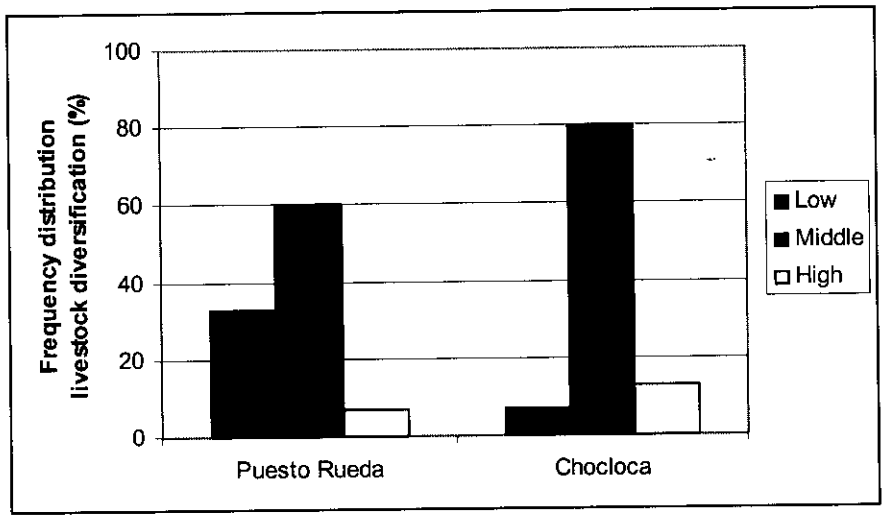

Fig. 5. Frequency distribution of Livestock Diversification Categories
Source: own survey

According to Table 13 and Figure 5, both communities show a middle diversification of livestock species, and no significant difference is apparent (Chi-Square value: 3.429 => not significant). Additionally, taking the total number of Tropical Livestock Units (TLUs) as a basis for comparison, it has been analysed whether a difference can be detected in the numbers of animals owned by the households. In Chocloca, the farmers possess on average 39.3, in Puesto Rueda only 21.1 TLUs. Applying the t-test, a significant difference at the 1% level is observed, indicating a higher number of animals is kept by households outside of the Reserve.

IV. Livestock Diversification Indicator II – Function categories

Moreover the livestock species have been assigned to five groups consistent with the functions they fulfil in the study area as explained in 5.1.3.: 'Large Home' (LH) and 'Small Home' (SH) animals, 'Cash' (CA), 'Draught' (DA) and 'Transport' (TA) animals. Seven groups have been formed according to the combinations that have been observed in the villages. These have been ranked and assigned to the three diversification categories (see Table 4, Annex VI). As a next step, the frequency distribution for each category has been calculated and corresponding percentages can be seen in Table 14. In Chocloca a high diversification (53%; mode: 3) regarding the functions of the animals is apparent, whereas in Puesto Rueda only a middle diversification (67%; mode: 2) is seen. Using the Chi-Square test (Value: 13.529 => significant at the 1% level) a difference in the diversification indicator of the functions of livestock can be observed.

5.2.2. Livelihood diversification

Regarding the second variable of the diversification of livelihood strategies, three indicators have been selected for its characterisation and analysis. The importance within this dynamic lies with activities other than agricultural ones, which form part of the strategies of the farmers to sustain a living. The indicators are very specific to the livelihood system encountered in this region. They comprise of those activities which were found in the preliminary literature review of the study area and were additionally mentioned by the households as being of high importance to them. As before, these indicators will be assessed regarding diversification and a comparison between both communities will be drawn up.

I. 'Para- and non-agricultural activities' Diversification Indicator

This indicator has been selected on the grounds of the households using the resources of their immediate surroundings. These can be used either for home consumption to complement the diet or as construction materials, as well as for further processing and consequently sales. Three different activities have been considered and their frequency distribution in both communities is graphically displayed in Figure 6:

- simple manufacturing and sales of products (honey production, further processing of wool) (SM)
- fishing and hunting (FH)
- timber extraction, which is illegal, but an important income source (TE)[13]

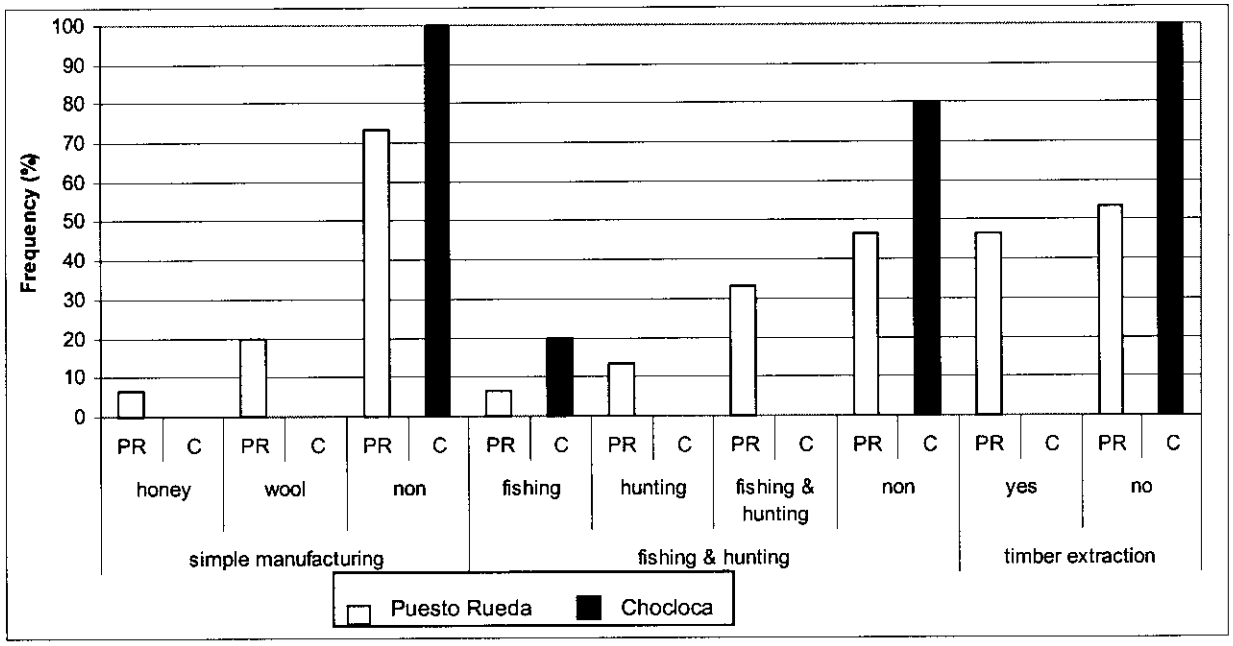

Fig. 6. Frequencies of non-agricultural activities within research villages
Source: own survey

[13] This is a very sensitive topic, and most households would not easily give data on this issue. However, after longer conversations, some farmers opened up and discussed this problematic issue. Additionally, the rangers assisted with the data collected on detection of illegal transport of timber out of the Reserve.

These activities have been put into groups, according to five different combinations which have been observed. Consequently they were assigned to ranks (Table 5, Annex VI for categories), and three categories obtained to show a degree of diversification for the indicator.

Table 15. Frequency distribution of Livelihood Diversification Indicators

Diversification category	Diversification Indicator Non-agricultural activities (%)		Diversification Indicator Non-monetary exchange (%)	
	PR (N=15)	C (N=15)	PR (N=15)	C (N=15)
No	27	80	7	53
Low	33	20	67	40
High	40	0	27	7

Source: own survey

Looking at the frequency distribution in Table 15 it becomes obvious that diversification regarding the use of other products is much higher inside the Reserve than outside (mode for Chocloca = 0 (80%); Puesto Rueda = 3 (40%)). Applying the Chi-Square test at the 1% level a significant difference (Chi-Square value 10.500) is observed. Thus, it can be concluded that para- and non-agricultural activities are more prevalent inside the Reserve than outside.

II. 'Non-monetary exchange' Diversification Indicator

This indicator assesses whether non-monetary exchange is practised within the research villages and which products are exchanged. It indicates whether farmers use this informal market not only to be able to diversify the access to a greater variety of products, but also to establish and maintain a social network amongst friends and relatives from other communities. The following products are exchanged:

- seeds and crops (maize, potatoes, wheat, quinua)
- livestock (poultry) and animal products (eggs, fat, wool)

These have been assigned, according to combinations observed, into four groups and ranked (Table 5, Annex VI for categories). Again three diversification categories are obtained for the indicator.

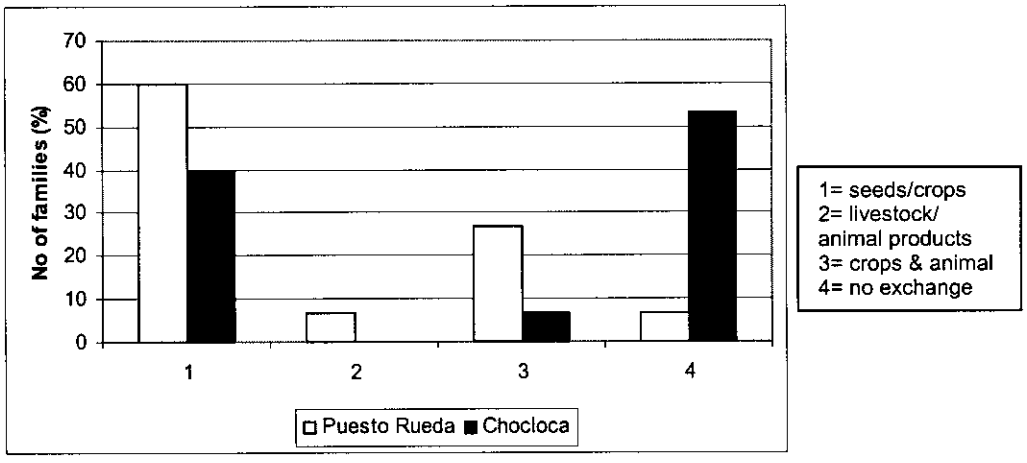

Fig. 7. Frequency distribution of families engaged in non-monetary exchange of products

Source: own survey

Figure 7 shows clearly that the non-monetary exchange, especially of seeds and crop products is very pronounced in Puesto Rueda; 60% of the households are engaged in this form of barter. In Chocloca, more than 50% of the households do not exchange at all. Table 15 shows the frequency distribution for the indicator and in Chocloca the dominant diversification value shows there to be no diversification (53%; mode 0) and in Puesto Rueda to be low (67%; mode 1). A difference at the 5% level is observed (Chi-Square value: 8.244), it can be concluded that the diversification is higher inside the Reserve than outside regarding the non-monetary exchange of products.

III. Off-farm Employment Diversification Indicator

It is fairly common for the farmers in this region to be engaged in other employment apart from working on their own farms, in order to supplement their incomes. Figure 8 shows that in Puesto Rueda 60% of the households have at least one member working off-farm as a wage labourer, 7% are self-employed and only 33% of the families are not involved in off-farm employment. In Chocloca nearly half of the households have no members working off-farm. However, if they do, more are either self-employed or have other types of employment than working as wage labourers; they have their own shops, sell meat, or work as teachers.

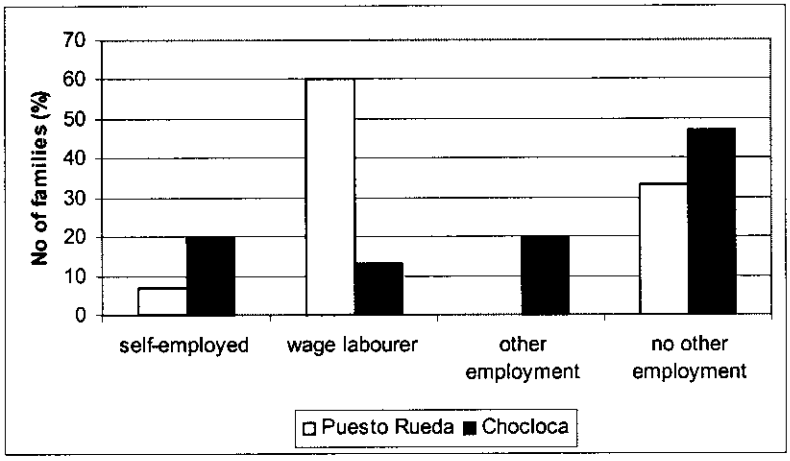

Fig. 8. Off-farm employment categories
Source: own survey

The diversification indicator assesses whether household members are employed in off-farm labour or not (Table 16). The degree of diversification is not relevant for this indicator, as the number of household members working off-farm, for example, does not show whether a higher or lower diversification is apparent. This only depends on the total number of household members and hence the availability of members to work off-farm. Therefore, the indicator simply assesses whether there is diversification or not.

Table 16. Frequency distribution of Diversification Indicators: Employment and Migration

Diversification category	Diversification Indicator Employment (%)		Diversification Indicator Migration (%)	
	PR (N=15)	C (N=15)	PR (N=15)	C (N=15)
No	33	47	13	27
Yes	67	53	87	73

Source: own survey

Analysing the data, in both villages diversification regarding off-farm employment is apparent (mode: 2), and no significant difference between the two can be observed (Chi-Square value: 0.556 => not significant). However, in Puesto Rueda a higher number of families (67%) have at least one member working off-farm, in total 19 members of all interviewed households, whereas in Chocloca this is the case for just over 50% of the families, and only 9 members in total work off-farm.

5.2.3. Migration

As has been explained in 5.1.7., migration is a very important part of the livelihood strategies of all farmers in the entire region. Different types of migration are apparent: permanent migration, where the household member permanently settles in another place away from his community of origin and only returns for occasional visits; temporary migration, where the person works between four and six months away from the home community; and educational migration, where mainly young people leave their home for often up to eleven months per year to attend school or university in a bigger city. Several push and pull factors determine the decision to migrate (Figure 9), although these differ between the communities.

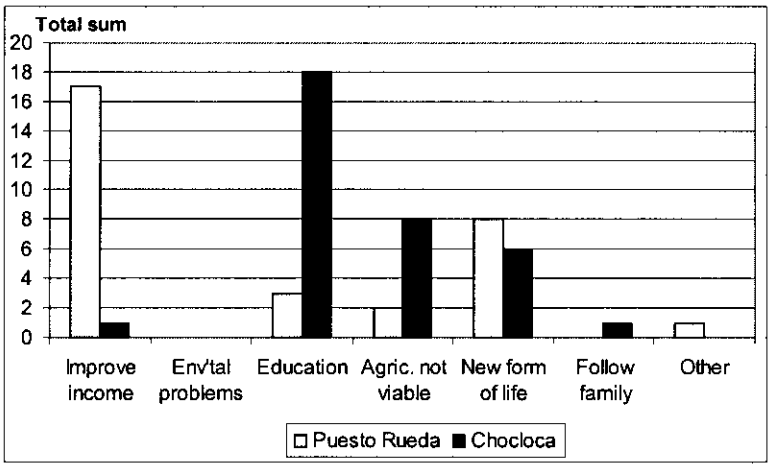

Fig. 9. Reasons for migration. Multiple answers were possible
Source: own survey

In Puesto Rueda, the main reason for migrating is to improve the income, whereas in Chocloca the principal reason was education, followed by the motivation to follow the family. Hence, looking at the type of migration in the two villages (Figure 10) it can be seen that in Puesto Rueda temporary migration dominates (53%), - whereas in

Chocloca permanent migration (27%) and the combination within the household of permanent, and migration for education purposes (27%) is common.

The Diversification Indicator (Table 16) looks at whether one or more members within the household do or do not migrate, regardless for whichever reason. In both communities the indicator shows that migration dominates (mode: 2) and in Puesto Rueda 73% of the households, and in Chocloca 87% of the households, have at least one member migrating. A marginal bias towards Chocloca can be observed, if the total number of household members migrating is also considered, on average 1.9 in Puesto Rueda and in Chocloca 2.2 members migrate. However, no statistical difference is observed between the villages (Chi-Square value: 0.833 => not significant).

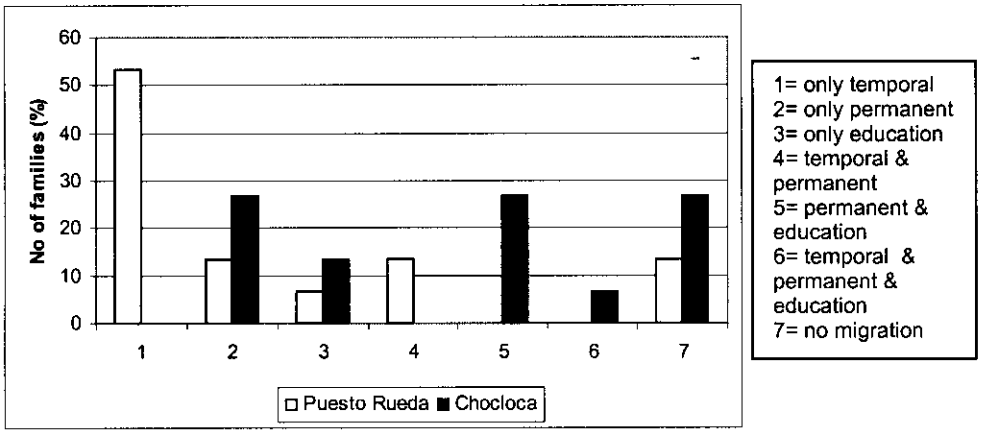

Fig. 10. Type of migration (combinations of migration types apparent in households)
Source: own survey

5.2.4. Summary and Discussion

To summarise, according to the calculations and tests conducted, the indicators for the crop and species composition farmed by the households show a middle diversification and no differences between the communities. For both indicators regarding the function categories, a high diversification is observed in Chocloca and a low diversification amongst the crops, and a middle one amongst the livestock in Puesto Rueda. From a statistical viewpoint, within Chocloca a higher diversification is apparent. Therefore the on-farm diversification is higher in the community outside of the Reserve.

Within the livelihood diversification variable, Puesto Rueda displays a significantly higher diversification for two indicators – non-agricultural activities and non-monetary exchange – and for the third indicator – off-farm employment – even though within both communities diversification is apparent, no significant difference is observed. To conclude, the community inside the Reserve is more diversified regarding this second variable.

For the migration variable one indicator has been analysed. Both villages reveal diversification, which means that at least one household member migrates. No statistical difference between the communities is disclosed for this variable.

The following Table 17., summarises these results. The mode for every indicator for both villages is indicated. In the last column the community showing the higher diversification value is shown, in case a significant difference is observed.

Table 17. Summary of diversification variables

Variable	Indicator	Diversification Categories			Higher statistical diversification[a]
		Low	**Middle**	**High**	
1. On-farm Diversification	**Crop Composition**		PR / C		
	Crop function categories	PR		C	C ***
	Livestock composition		PR / C		
	Livestock function categories		PR	C	C ***
		No	**Low**	**High**	
2. Livelihood Diversification	**Non-agricultural activities**	C		PR	PR ***
	Non-monetary exchange	C	PR		PR **
		No		**Yes**	
	Off-farm employment			PR / C	
3. Migration	**Migration**			PR / C	

*** significant at 1% level, ** significant at 5% level, * significant at 10% level

[a] The community with the higher diversification value is shown

Source: own survey

Variable one shows Chocloca to have a higher diversification, whereas variable two shows Puesto Rueda to have a higher diversification, and no significant difference is observed for variable three. The first two variables neutralise each other, therefore the second Null-hypothesis, that no difference in diversification exists between both communities, has to be accepted.

It is interesting to observe that for the production system variable, Chocloca exhibits a higher diversification, whereas in Puesto Rueda households diversify much more with regard to other activities. Obviously, this is linked to the commercialisation factor; farmers outside of the Reserve have access to markets, hence are more profit-oriented and the majority of them sell a part of their produce. In Tariquía many limitations are set for this factor and it is not a profitable option for farmers to commercialise their production. Hence, further activities have to be explored and used to generate additional income and a greater access to products and resources. The social network plays an important role for farmers being informed regarding new production possibilities. The illegal activity of timber extraction unfortunately still offers one of the most profitable income sources to the households.

Even though no statistical difference is revealed for off-farm employment between the villages, it is revealed, that in Puesto Rueda a high proportion (60%) of household members is employed as wage labourers. In Chocloca only 12% follow these low-income off-farm jobs, indicating a difference in the type and quality of employment obtained.

Migration is a common strategy of many rural households in this region regardless whether they live inside the Reserve or in the surrounding areas. Traditionally, in the Department Tarija many young people and farmers either migrate on a temporary or a permanent basis to northern Argentina, as wages are higher than in Bolivia and many jobs were available due to the much better financial situation of the country (HINOJOSA *et al*, 2000). However, because of the financial crisis in Argentina in the last few years and the recent economic developments, fewer people are attracted by this option. Tarija, Padcaya and Bermejo are other destinations for migration within the Department; Sucre and especially Santa Cruz have also been mentioned to be attractive for migration purposes.

5.3. Relationship between the Production System and Livelihood Strategies

Several factors can trigger diversification; they can be of a financial nature, caused by environmental problems, resource scarcity or new legislations. Usually they do not act in isolation, but are interlinked. This study takes the step of assessing the degree of association between the productive performance of a farming system and the diversification strategy within the households. Generally it is assumed, that due to low performance and limited financial possibilities within the production system, further activities will be pursued and an expansion of strategies will take place in order to survive. It cannot be assessed whether there is any causality between the variables, however the strength of the relationship can be detected.

Four working variables have been taken to define the main variable: 'productive performance of the farming system' (scale of farming, productivity, profitability and resource usage in farming), and three working variables for the second main variable 'diversification of livelihood strategies' (on-farm diversification, livelihood diversification and migration). Each working variable has been assigned between one to four indicators, as seen in Table 12. and 17. For the performance variables, the results of each indicator belonging to one variable have been summed up and divided into the same three performance categories (low, middle and high) as used before in Chapter 5.1.6. These allow to obtain a standardised ranking system for every variable and make them comparable. For the three diversification working variables, as the indicators used were not all grouped in ordinal data (livelihood diversification and migration are nominal indicators), the ranking results of the indicators forming part of one working variable of every household were summed up. These were divided into three or, where necessary four categories: high, middle, low and no (see Chapter 5.2.4. for formation of diversification categories). The frequency distribution for each variable (in percent) from the cross-tab calculations and the Chi-Square value can be looked up

in the Annex VI, Table 6. The following Figure 11 shows the distribution of the categories graphically and Table 18 summarises the central tendencies for each working variable.

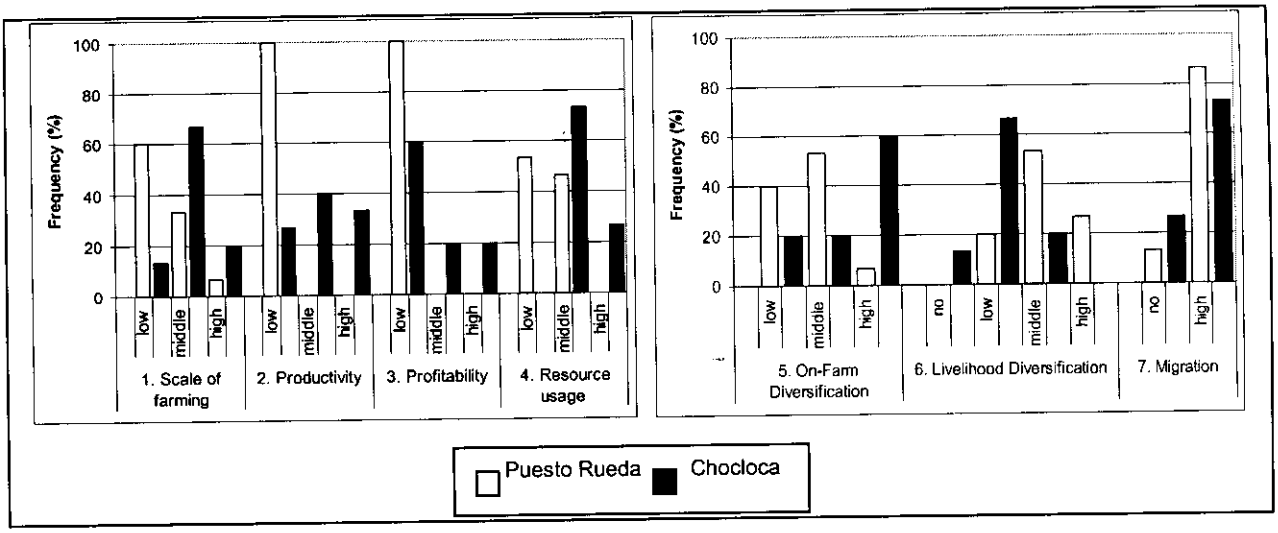

Fig. 11. Frequency distribution of all working variables
Source: own survey

For all variables, apart from migration, a significant difference between the two communities can be observed. As already discussed in the previous sections, Chocloca is ranked higher for the performance variables, whereas among the diversification variables mixed results are revealed for Puesto Rueda.

Table 18. Summary of central tendencies of all working variables

Variable	Performance Category			Higher statistical value[a]
	Low	Middle	High	
1. Scale of farming	PR	C		C**
2. Productivity	PR	C		C***
3. Profitability	PR / C			C**
4. Resource usage in farming	PR	C		C***
5. On-farm Diversification		PR	C	C***
6. Livelihood Diversification	C	PR		PR***
7. Migration			PR / C	

*** significant at 1% level, ** significant at 5% level, * significant at 10% level

[a] The community with the higher value is shown

Source: own survey

Eventually the working variables have been grouped together to form the two main variables: productive performance and livelihood diversification. The rank values have been added up from all four or three variables, and again divided into three categories:

low, middle and high. This allows the category of 'no diversification' which has a zero value to be taken into account from the two variables livelihood diversification and migration. Now the strength of the relationship between the two variables can be assessed using the contingency coefficient, phi.

First, analysing both variables separately, a significant difference between the two communities can be observed in terms of productive performance; the result is statistically higher for Chocloca. The Chi-Square value of 16.562 and a 1% significance level supports the rejection of the first Null-hypothesis from Section 5.1., that there will be no significant difference between the productive performance of the farming systems of the communities within the National Reserve compared to the communities in the Valle Central, indicating that the difference did not occur by chance alone. The livelihood diversification variable shows no significant difference between the two communities (Chi-Square value: 1.250 => not significant), supporting the failure of rejection of the second Null-hypothesis, that no difference in diversification exists between both communities, as discussed in Section 5.2. (see Figure 12 for graphical illustration of both variables and Annex VI, Table 7 for cross-tab results).

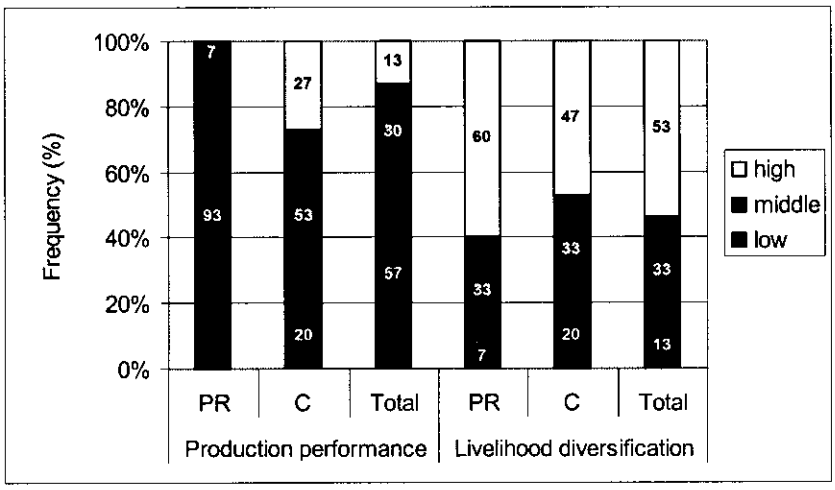

Fig. 12. Frequency distribution of two main variables within the communities

Source: own survey

Finally, the relationship between the two variables has been assessed using the phi value. In Puesto Rueda, the effect size is 0.218, showing no relationship, and no statistical significance is observed (the significance level => 0.700), whereas in Chocloca the phi value is 0.667 which indicates a strong association between the two variables, but the significance level of 0.155 shows no statistical significance. For both villages taken together the effect according to the phi value 0.380 is medium, however the significance level of 0.362 shows this relationship not to be statistically supported. The following Figure 13. indicates the frequency distribution in percent of the comparison of the two variables, the values are displayed in the cross-tab table in the Annex VI, Table 8.

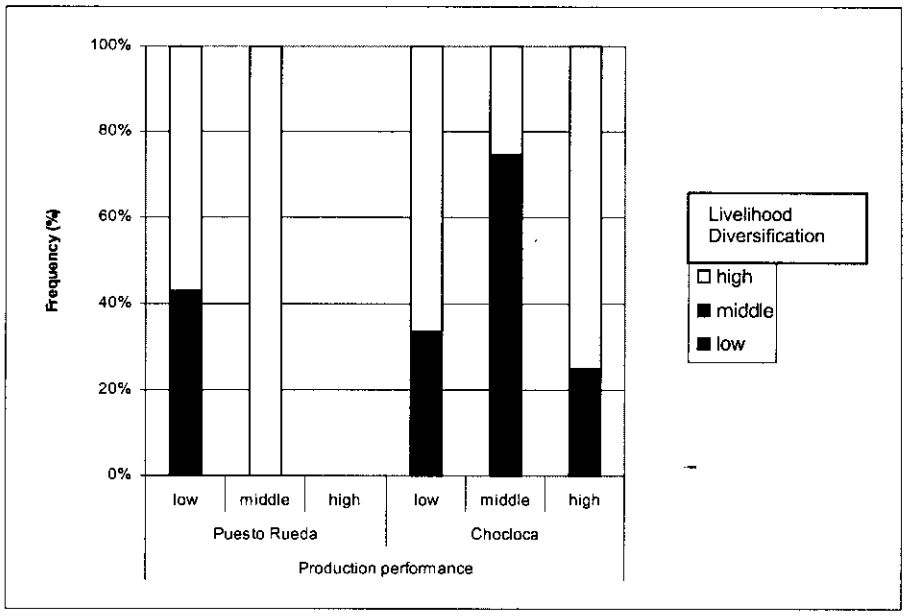

Fig. 13. Frequency distribution for productive performance vs. livelihood diversification
Source: own survey

Therefore the last Null-hypothesis is accepted and the working hypothesis that an association between the productive performance of a farming system and the diversification of the livelihood strategies exists needs to be rejected. It is important to note that the results obtained in the cross-tab calculations and applying the statistical test Chi-Square and the phi value most probably do not show significant differences due to the very small sample sizes in both groups. On a purely descriptive basis especially inside the Reserve, a tendency towards lower productive performance (93%) and higher diversification within the livelihood strategies (60%) is observable. This supports the assumption that farmers diversify their activities because of limited productivity within the production system (see Figure 12). For Chocloca this is not so clear cut; 53% of the households show a middle, and 27% a high productive performance and a high diversification of livelihood activities is apparent in all three performance categories. However, within the diversification variable, four indicators of the on-farm diversification are included, which constitute half of the weight. Since Chocloca displays higher values amongst these and in any case more importance is put on the farming activities, this might result in no association between the livelihood diversification and productive performance variables.

6. Conclusions and Recommendations

6.1. Land Use Systems in Tarija

The objective of the study has been to describe the land use systems, with reference to the production systems and livelihood strategies of the local population to provide an insight into these. Three objectives have been the centre of the discussion. The productive performance of the farming systems was appraised both for a community within the National Reserve Tariquía as well as in the influence zone of the Valle Central. Furthermore, the diversification of the livelihood strategies has been assessed as to whether a relationship can be established between these two variables.

The **production system** in Chocloca has a higher **performance** in the selected variables of **scale of farming, productivity, profitability and resource usage in farming**. With the help of statistical tests a significant difference has been proved between both communities. In any case, the starting point for the production systems in the Valle Central is different and the farming households have several advantages over those inside the Reserve. These are:

- the road network connecting them with other communities and cities and hence their proximity to markets;
- the irrigation system in the community allowing them to grow several cash crops which need constant watering, two harvests of potatoes per year, and the security of not having to rely on rainfall only for their crop production;
- the introduction of Holstein cattle into the area providing an additional income source, on average constituting 30% of the gross margin of the farming household.

Furthermore the households in the Reserve have the disadvantage of living within a protected area which puts certain constraints on them:

- the application of chemical fertilisers and other agro-chemicals is not promoted by PROMETA, hence its usage is restricted;
- the construction of a road leading into the Reserve improving access to markets for its population has long been objected to. Currently the plan for a road is being assessed and if approved, construction might start at the end of this year or beginning of the coming year 2002;
- the free usage of the forest and its resources is restricted, and timber can no longer be cut and sold without the permission of PROMETA.

The influence of climatic or soil conditions on the productivity of the production systems has not been assessed. However, Tariquía seems to have more favourable conditions than in the Valle Central, which is a very dry zone, as discussed in Chapter 3. Even though rainfall is higher in Tariquía, all households have mentioned an irrigation system to be amongst their priorities for the improvement of their farming systems. In Chocloca, which is situated in an erosion-prone zone, the irrigation system is essential to support the agricultural production.

The argument has been put forward that due to limited production possibilities a higher **diversification of livelihood strategies** will be encountered within the Reserve which might relax the limitations and restrictions faced by the local population. Three livelihood strategy variables were assessed: On-farm diversification, livelihood diversification and migration. After the application of statistical tests, the hypothesis that a significant difference between both villages exists has to be rejected. However, assessing each variable individually and not just on the basis of statistical differences, it is interesting to observe that within the **livelihood indicators,** Puesto Rueda exhibits higher diversification. Both for para- and non-agricultural activities and non-monetary exchange these differences were statistically significant, whereas for off-farm employment, even though no statistical difference is revealed, the absolute numbers indicates off-farm employment to be more prevalent in Puesto Rueda. In contrast, the tendency for **on-farm diversification** is higher in Chocloca. The two indicators taking the function categories of crops and livestock as a basis, exhibit significant higher values outside the Reserve; also the livestock composition indicator is biased towards Chocloca, although statistically this is not supported. The last variable **migration** reveals no significant difference between the communities, but the absolute numbers exhibit a trend regarding migration prevalence inside the Reserve. Hence, the diversification of strategies outside the on-farm production process tends to be higher inside the Reserve. The next step would be to undertake an economic valuation of these strategies, and assess the contribution of the off-farm activities to the net family income. This has been the focus of many studies where the importance of rural non-farm employment and incomes (REARDON *et al*, 2001) or the income of wood and non-wood forest products for households has been assessed (PERZ, 2001; BARHAM *et al*, 1999). In Latin America, rural non-farm income averages 40% of rural incomes (REARDON *et al*, 2001:396). Hence, the understanding of these strategies, as well as taking into account the fragile situation of the rural population, is of crucial importance for an appropriate programme design and policy formation.

The final consideration was the **association** between the **production performance** of the farming system and the **diversification of livelihoods**; statistically no relationship between both variables was established. Especially in Puesto Rueda, it was observed that the majority of households exhibit low productive performance and high livelihood diversification, whereas for Chocloca the data does not allow a trend to be established or obtain any indications of association between the variables.

It can be recommended that support is given to improve the performance of the production systems within the Reserve. The economic indicators reveal the pig enterprise, as well as the peanut enterprise to be the most productive as well as profitable enterprises, and hence should be promoted from an economic standpoint to raise the performance. However, various points need to be considered:

- regarding the application of gross margin calculations several shortcomings need to be mentioned (see also Chapter 2.2): an expansion of the enterprises with the highest land profitability might result in contrary effects when resource and other constraints are not assessed. The fixed cost components of the

enterprise need to be taken into account, whether these might not also increase with an expansion of the enterprise.
- improving the production of these enterprises only makes sense if farmers are given the possibility to access markets to sell some of their produce.
- due to its protected area status, it has to be assessed whether the promotion of these enterprises makes sense from an environmental and ecological standpoint, whether the sustainability of the natural resources can be maintained (see below for further discussion on sustainability).

In Chocloca, amongst the crop enterprises the peanut production, but also the tomato, vine and pumpkin enterprises, obtain high results for productivity and profitability. Similarly the pig production has good outcomes as well as the Holstein cattle enterprise. Obviously, as the production is already market-oriented, the promotion of further commercialisation of these enterprises is more realistic than inside the Reserve. In order to improve the marketing of their produce, the following options have been thought of, although they might not be easily realisable:
- improve the quality of agricultural products;
- diversify the production – introduce new and different crops;
- promote NGOs which are proficient in commercialisation and provide an extension service and courses;
- improve and extend the road network and transport possibilities;
- organise markets for farmers (sellers) and wholesalers (buyers) to have direct contact;
- provide common storage possibilities to be able to sell larger quantities.

For both areas it is necessary to conduct a market analysis in order to determine which local and regional products are economically interesting to produce. Additionally the agro-ecological conditions need to be appraised, as well as whether farmers have an interest and are motivated to adopt new enterprises. It is important to undertake all these steps to have the assurance of knowing which products to promote, especially when initiating the purchase of machinery or propagation of certain livestock. Furthermore the awareness of the local population and buyers should be raised regarding the value of local and regional products for the socio-economic development of the region. The provision of extension services and further education for farmers to improve the quality of their products and know- how to combat diseases and pests, is essential for agricultural development.

However, the commercialisation of agricultural production can also bring with it difficulties. Changes in the intensity and structure of the agricultural production can shift the significance of cultivation and livestock for the individual farming unit. If the cultivatable area is limited, a rise in commercialisation of the produce is only possible by decreasing subsistence production, unless the productivity of the subsistence production is increased, for example, by using improved seeds or fertiliser. Additionally it might initiate the reallocation of mixed cropping to monoculture. Apart from the reallocation of the productive land, a reallocation of labour is possible, as more labour will be invested in market production in comparison to subsistence production. If the

labour productivity for the subsistence production is not to be increased or more wage labourers to be employed, subsistence production will start to decrease (KERN-BECKMANN, 1999).

The promotion of the productivity of the agricultural systems within Tariquía is a sensitive issue, since it is a protected area. The assessment of the impact of the production systems on the environment has not been the objective of this study. Within the context of conservation inside a protected area, the ecological sustainability of new options need to be appraised, such as which effects an intensification of enterprises or the introduction of new ones have. The intensified usage of production inputs such as agro-chemicals can easily have negative side-effects, therefore agro-ecological methods for organic agriculture should be further investigated and promoted. These techniques imply rotation of crops, organic fertilisation, etc. (DE SILGUY, 1994). It is feared that the increased productivity of the farming systems in Tariquía might attract further settlers, which is obviously not an appealing idea for a protected area. However, the production conditions in other areas will probably always remain more advantageous due to better road networks and closeness to markets. Purely from a conservation point of view it would be interesting to promote the agricultural production outside the Reserve. This could stimulate a further out-migration and allow for more conservation of the natural resources inside the Reserve. However, this stands in contrast to the human development of the local population who also have a right to live in Tariquía and use the resources (sustainably) as they have always done.

Due to the disadvantages facing commercial production in Tariquía in comparison with other areas, it is especially important to promote and support further diversification of livelihood strategies and possibilities for income generation. Ever since the cutting and sales of timber have been prohibited, households have been struggling to obtain sufficient income for food purchases or for the education of their children. Currently an apiculture project is being carried out by PROMETA, of which 41 households in the centre of the Reserve are beneficiaries (only one household in Puesto Rueda). PROMETA also supports a pig programme with the introduction of improved maize varieties to sustain and improve pigs, and employs a veterinarian who, when he is present in the Reserve, advises and assists farmers on vaccination of livestock and all other related matters (castration, etc). However, further options should be investigated, such as agro-forestry systems of tree and legume crops inter-planted with annual and perennial crops or plantations of valuable tree species which would benefit the local population. Obviously, as it is a protected area, the environmental impact of new options should always be appraised before the implementation of these. Also for the rural population of the Valle Central, a diversification of income sources is of interest and needs to be promoted. Various Non-Governmental Organisations in Tarija are working on rural development projects and should carry on to pursue and strengthen these efforts.

6.2. Research methodology

Some observations regarding the applicability of the employed research methods have already been explained in Chapter 4. The usage of quantitative methods such as applying structured questionnaires to a randomly selected sample has many advantages, such as obtaining data on measurable variables and being able to generalise results, as they can be taken to be representative. It enables causal explanations and predictions to be made. Qualitative methods on the other hand use a case study approach with limited observation units and apply instruments such as participant observation or unstructured in-depth interviews. These allow events from the viewpoint of participants to be understood. The importance of the subjective, experiential 'life-world' of human beings is recognised (BURNS, 2000).

It was felt important to work with a randomly selected sample of villagers, as data and opinions from a variety of households could be obtained and a bias, when only talking to very responsive and collaborating people, was avoided. In the end, more quantitative methods have been used for this study. However, sometimes the validity of the data provided by respondents was doubtful, and due to the rigidity of structured interviews not enough space was left to follow up small details and comments. It was then through informal talks, that some data was cross-checked and improved. As human beings have been the centre point of the study, and they do not behave or respond always in an anticipated or desired rational manner, plans need to be changed, and flexibility allows to obtain the necessary information. This implies spending more time with individual household members and talking about a variety of issues not necessarily connected with the study, but this allows to gain their confidence and count with their collaboration. Both methods have their limitations but a combination is useful as they can complement and support each other.

Epilogue

This research has brought me further not just in academic terms, but in many other practical ways. I have executed a project on my own, but obviously with much assistance, input and help of many people. However, in the end it was my project for which I am responsible and for which I had to go through the process of gathering and processing all the necessary information to write this thesis. The field work, in particular, has been a very important part of this study, and the wider experiences gained from simply listening and talking to the local villagers cannot be reflected in the scientific part of this study. One of the main lessons of participatory method for me in carrying out the study, was learning to listen to people and give them the time they needed to overcome their inhibitions and mistrust of strangers, allowing them to express their opinions freely. Obviously, to some extent, this can be brought about by using certain stimulation techniques. But the experiences and insights gained on the ground cannot be taught in the classroom or read up in textbooks. One has to do it by oneself in order to know what it means to work on a village basis in the rural setting.

Experiencing the different lifestyle was a living part of the research, and taught me much; which made it very special for me. The farmers always invited me to eat in their houses, regardless how poor they were, and the best they had was served to me. The setting of the study and the circumstances were an adventure in itself. It took me two days walking to reach the centre of Tariquía, and every day an hour's walk to reach Puesto Rueda and an hour to return to PROMETA's research station. This was fantastic at the time, but constantly to live under these circumstances can be a tough job. I had to learn how to ride horses, cross rivers (both by foot and horse) and fall into them (off the horse). Solitude is a topic which many researchers are familiar with when living in remote areas. Even though I was usually not alone, there were still times when I would wish for a familiar friend with whom I could talk about all the different experiences I was facing.

There is also the whole process of writing a thesis, when one starts to question all the work already done, and begins to doubt whether what one is doing is relevant, wondering how all the mental chaos inside oneself can be put into order. But then, to discover the beauty of assembling all the information and data, and making one piece of work – a dancing star - out of it, makes it all worthwhile.

I am glad I have had the chance to undertake this research.

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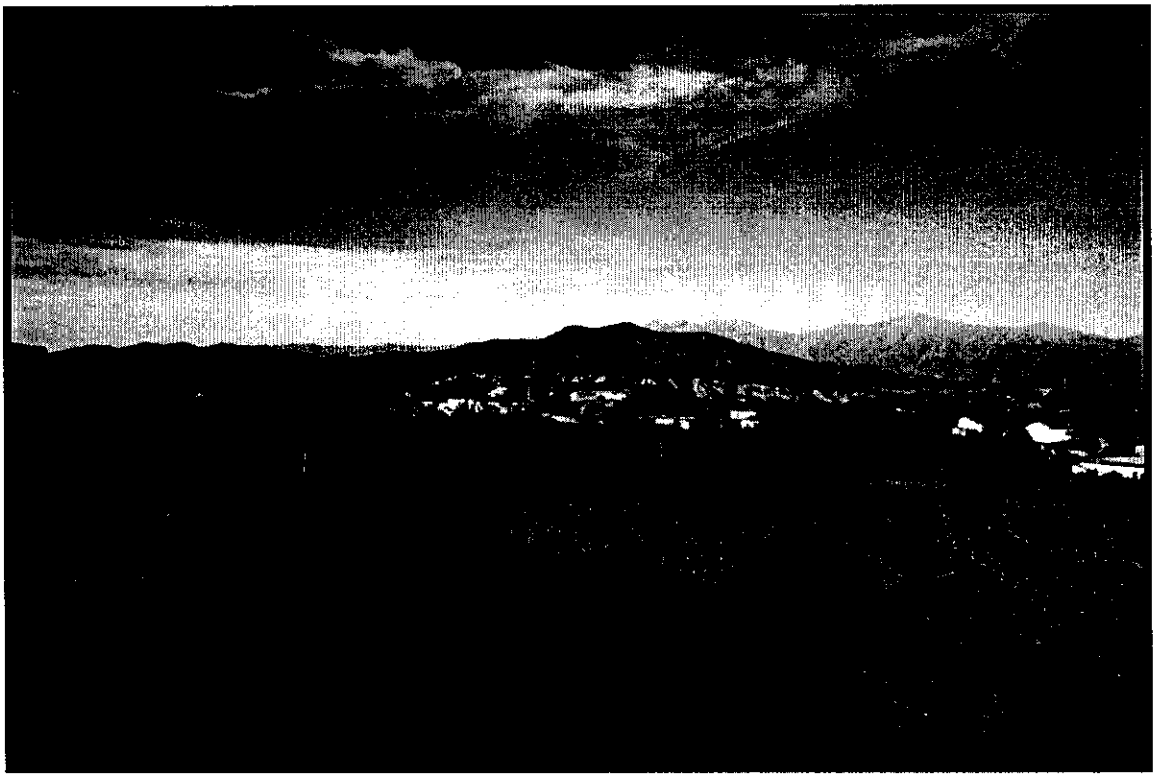
- INE: Instituto Nacional de Estadìstica: *http://www.ine.gov.bo*
- FAO: Food and Agricultural Organisation: *http://www.fao.org*
- World Bank: *http://www.worldbank.org*

ANNEX

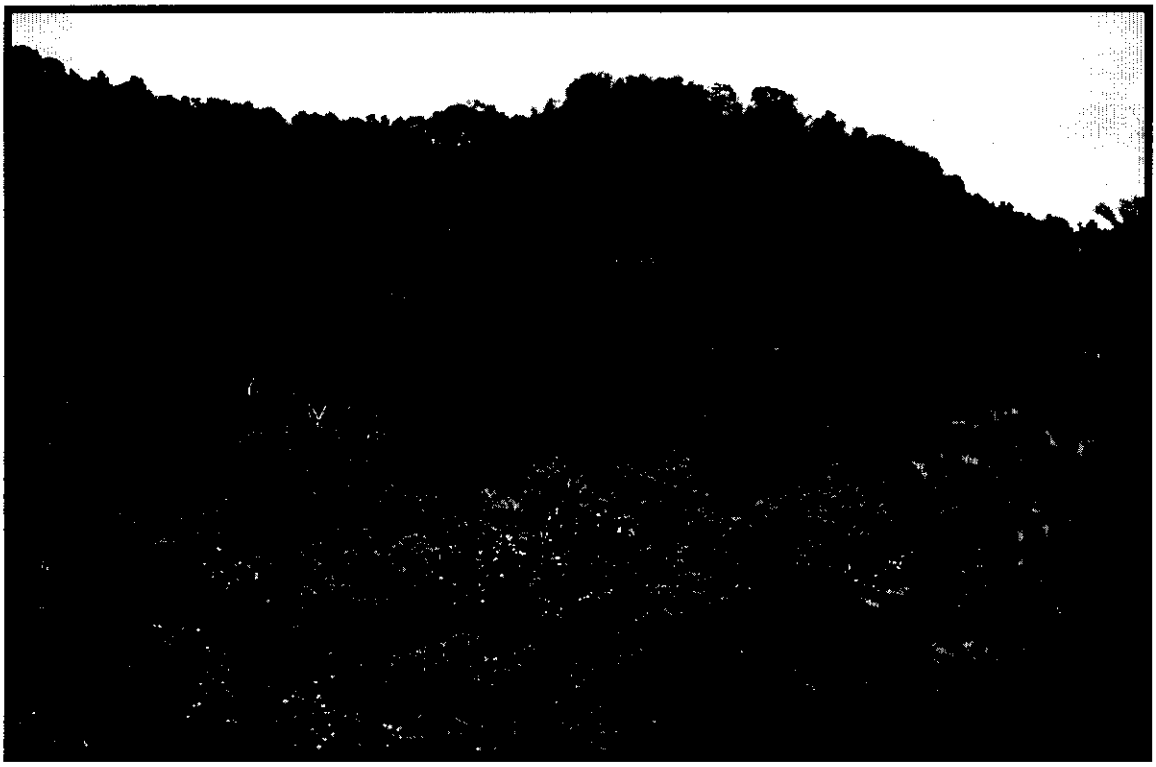
Annex I: Pictures of impressions of study area

Picture 1. Centre of Reserve Tariquía (Pampa Grande) upon arrival

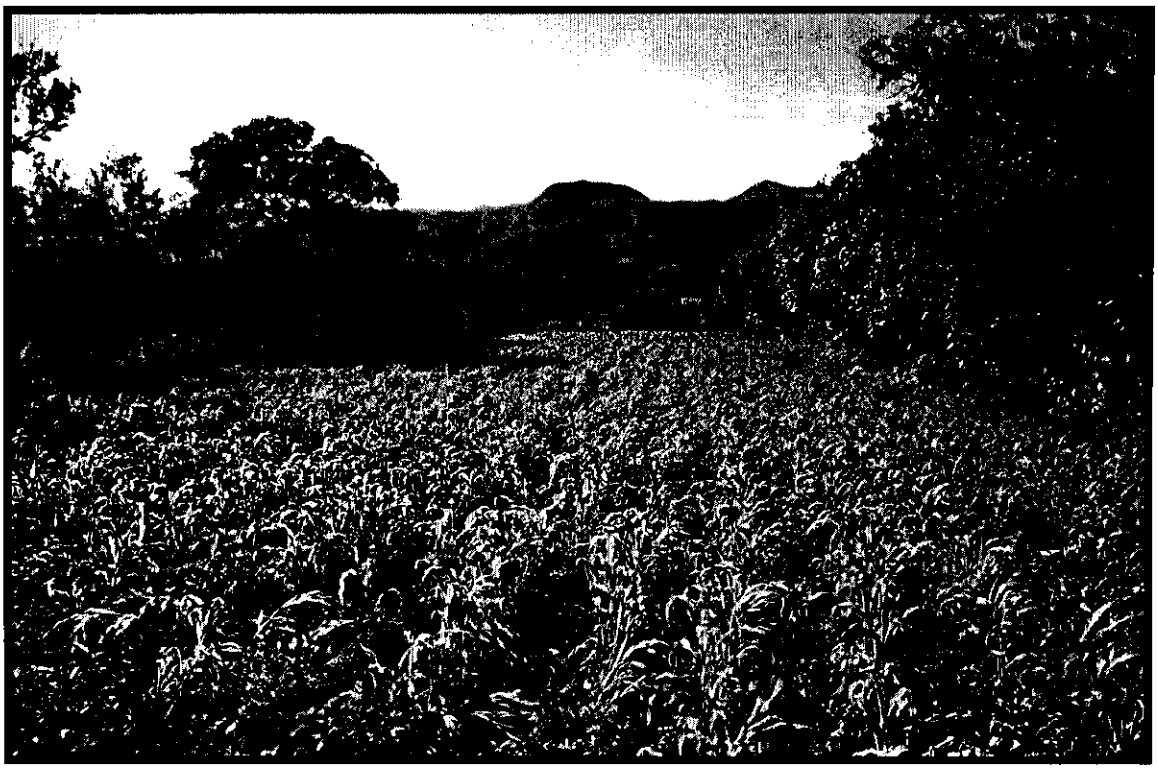
Picture 2. Community Chocloca in the Valle Central



Picture 3. Cultivation in the '*monte*' in Tariquía



Picture 4. Maize cultivation in Chocloca



Picture 5. Diversity of livestock in Puesto Rueda

Picture 6. Holstein cattle farming in Chocloca

Annex II: Questionnaire (for Puesto Rueda)

Cuestionario No. ___ Fecha: _____
Código del hogar: _____ Comunidad: _____

Nombre y Apellido del contestador _____

Relación con la cabeza de la familia_____

Nombre y Apellido de la cabeza de la familia_____

Actividad principal de la familia _____ Auto clasificación _____

1= pudiente, 2= menos pudiente, 3= pobre

1. Estructura de la familia - *calendario agrícola*

No.	Miembros familiares, nombre	Relación con cabeza de familia	Sexo 1=M 2=F	Edad	Escolarización	Actividades
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Relación cabeza familia: 1=cab. familia, 2=esposo/a, 3=hijo/a, 4=p/madre, 5=abuelo/a, 6=nieto/a, 7=otro pariente, 8=otro
Escol: 1= Primaria (1-5), 2= intermedio (6-8), 3= secundaria (1-4), 4= universidad, 5= otro
Actividad: 1= agricultura, 2= ganadería, 3= mixto (a+g), 4= forestal, 5= migr., 6= profesores, 7= Artesanos, 8= otro

2. Migración:

No.	tiempo	Donde	desde cuando hasta cuando	Actividad	Ingreso	razón de migración

Tiempo: 1= temporal, 2= definitiva **Donde**: 1=Tarija, 2=Argentina, 3=Bermejo, 3=Santa Cruz, 4=Rosillas, 5=otro **Actividad**: 1=Agricultura, 2= construcción, 3= educación, 4=trabajo domestico, 5=otro
Razón de migr.: 1=mejorar ingresos, 2=problemas climáticos y ambientales, 3= educación sec., 4= jóvenes: agricultura no viable , 5=nueva forma de vida, 6=seguir familia, 7= otro

Parte del ingreso mandado a familia: _____ 1=Sí, 2=No
Monto mandado por mes / año a familia:_____

3. Terrenos usados: - *mapa del terreno*

	cantidad (ha)		riego (ha)	utilización	calidad de la tierra	calidad de tierra hace 10 años	Tiempo de camino para llegar	Ubicación de parcela	ciclo de rotación de parcelas	derechos de propiedad
Cultivado (Potrero)	cultivado	total								
- Valle (huerto)										
- Monte										
Pastoreos										Asentados Herbajeros
- Valle										
- Monte										
Barbecho										
Extracción madera										
Total										

Periodo de utilización por ano: A/B: A=meses de uso / B=meses de descanso
Calidad de tierra: 1= mas erosión, 2= menos erosión, 3= poca erosión, 4= menos rendimiento, 5= poca fertilidad, 6= seca, 7= mas rendimientos, 8=buena, 9=otro
Ubicación de parcela: 1=pendiente (desmonte), 2=plano, 3=otro**Ciclo de rotación de parcelas:** A/B: A= años de uso, B=años de descanso
Derechos prop.: 1=propiedad (C=compr, H=herencia), 2=arriendo, 3=Pro-indiviso, 4=asentados, 5=herbajeros, 6=a medianería, 7=sin titulo, 8=del estado, 9= otros

3a. Si se trata de arriendo, cuanto es el precio del alquiler por ha: _____

3b. A medianería: quién es propietario, quien pone semillas, quien insumos, cual porcentaje de los rendimientos recibe?

_____

4. Situación de agua: - *mapa del terreno*

	lugar de toma (donde)	calidad	infraestructura	costo de instalación	fecha de instalación	cual periodo se puede usar (vida útil)
para consumo						
para cultivos						
para animales						

Calidad: 1= agua potable, 2= con sal, 3=mal (porque?) , 4= otro
Infraestructura: 1=pozo, 2= cañería, 3 =sistema de riego, 4= rió, 5= quebrada, 6= vertiente natural (pujío) 7=otra

5. Cultivos: - ***mapa del terreno***

			Autoconsumo			Venta			Compra			
Tipo	ha sembrado	rendimientos (c, q, a/ ha)	cantidad para alimentación familiar	cantidad usado como insumo	del insumo producto obtenido	cantidad	precio	lugar	lugar	fecha	cantidad	precio
Maíz			humano animal									
Maní												
Papa												
Poroto												
Camote												

Tipo: 1= Maíz, 2= Maní, 3= Papa, 4=Poroto, 5= Camote, 6= Caña, 7= Hortalizas (lacayote, zapallo, cebolla), 8=Arveja, 9=Yuca, 10=Palta, 11= Ajipa, 12= Sidra, 13= Durazno, 13=Naranja, 14= Lima, 15= Mandarina, 16= Pomelo, 17= Tabaco, 18= otro
Lugar: 1= Mercado local, 2= Tarija, 3= Bermejo, 4=Padcaya, 5=otro lugar

5a. Que tipo de enfermedades y plagas ocurren con los cultivos? _____
1= gusano cogollero (maíz), 2= pasmo amarillo (maíz), 3= pasmo negro (maíz), 4= sambera de la hoja (maní), 5= gomosis (cítricos), 6= sequía, 7= lluvia, 8=animales, 9= pájaros, 10=otro

5b. Que método se usa para combatir?_____
1= agua de tabaco, 2= químico, 3= herbicida, 4= insecticida 5= plaguicida, 6= rotación de parcelas, 7= rotación de cultivos, 8= gusano, 9= rifle, 10=otro

Que tipo de químicos se usa ? _____

5c. Hoy en día hay mas enfermedades que hace 10 años? _____ 1=Sí, 2=No

5d. Si hay mas enfermedades ahora que antes, que efecto tienen para Ud.?_____
1= menos rendimientos, 2= plantar mas, 3= dejar tierra y buscar nuevas tierras, 4= uso de mas remedios (cuales?), 5=otro

5e. A que mercados / ferias lleva Ud. sus productos para vender y cuantas veces los lleva ?

_____

5f. Intercambio de productos de cultivos dentro de la comunidad _____ , con otras comunidades (vecinas)?_____1=Sí, 2=No

5g. Intercambio de semillas dentro de la comunidad _____ , con otras comunidades (vecinas)?_____1=Sí, 2=No

5h. Si no tienen mas semillas de maíz (otros cultivos) que hacen? _____

5i. Por que motivo se hace intercambios?_____
1=escasez de comida, 2=no hay mercado, 3=mejoramiento de cosecha, 4=se trae cosas que no hay aquí, 5= otro

5j. Que se intercambia por productos de cultivos / semillas?_____

5k. Con cuales comunidades se hace intercambio ?_____
1= Pampa Grande, 2= Motovi, 3= San José, 4=Acherales, 5=Acheralitos, 6=Orozas, 7= Rosillas, 8= otro

5l. Si hay una helada y se pierde toda la producción, que hacen? _____
_____

5m. Que productos (de comida) tienen que comprar en Tariquía / en Tarija? _____
_____

6. Medios de producción / herramientas para los cultivos:

				Compra / alquiler				Mantenimiento		
Tipo	Adquisición	cantidad	frecuencia de uso	fecha	lugar	precio	financiamiento	frecuencia	costo	vida útil

Tipo: 1=machete, 2= hacha, 3= pico, 4= azada, 5= lampa, 6= tipina (deshojador), 7=kimpi (bolsa), 8=costales, 9=semillas, 10=plantas, 11=jornales de peones, 12= estiércol, 13=abono químico, 14=fungicida, 15=plaguicida, 16=fertilizante natural (guano), 17=herbicida, 18=insecticida, 19=buey, 20=arado de palo, 21=burro, 22=otro
Adquisición: 1= insumo, 2= comprado, 3=fabricado, 4=intercambiado, 5=alquiler, 6= prestado, 7=otro
Frecuencia: 1= cada día, 2= una vez por la semana, 3= una vez por mes, 4= cada 6 meses, 7=en la época de invierno, 8= en la época de verano (sequía), 9= otro
Financiamiento: 1= a plazo, 2= al prestado, 3=al contado, 4=otro

7. Ganado:

									Venta			Compra			
No	Tipo	Cantidad /enjambre	Composición del hato	n. de nacimiento por año	cantidad autoconsumo	Cantidad enfermos (año)	Cantidad intercambio (año)	Cantidad muertos	cantidad	precio	lugar	Cantidad	Precio	Lugar	fecha
1	bovino criollo														
2	bovino lechero														
3	chancho														
4	oveja														
5	cabra														
6	burro														
7	mula														
8	caballo														
9	gallina														
10	abeja														
11	otro														

Composición del hato: B= bueyes, T= toros, F= vacas, V= vacillas, N= novillos, H= toretes, J= terneros +no (cantidad) del hato

7a. Intercambio de ganado dentro de la comunidad _____ y con otras comunidades (vecinas)?_____ 1=Sí, 2=No

7b. Con cual ganado se hace intercambio y que se recibe?_____
1= ganado vacuno, 2= chancho, 3= gallinas, 4= oveja, 5= otro; 1= trigo, 2= quinua, 3= arroz, 4= otro

7c. Por que motivo se hace intercambios?_____
1= escasez de comida, 2= no hay mercado, 3= no hay el producto por aquí, 4= otro

7d. Que tipo de productos animales obtienen?

8. Productos animales obtenidos:

		Autoconsumo			Venta			Compra			
No	Tipo	cantidad aliment. familiar	cantidad como insumo	insumo producto obtenido	cantidad	precio	lugar	lugar	fecha	cantidad	precio
1	Leche										
2	Carne Vaca										
	Chancho										
	Oveja										
	Gallina										
3	Huevos										
4	Cuero										
5	Lana										
6	Miel										
7	Manteca										
8	otro										

8a. Se hace intercambios con los productos animales (cuales) y por que cosa se cambia ?_____

_____

8b. Que tipo de enfermedades ocurre con el ganado? _____
1= orina sangre, 2= rabia , 3= fiebre aftosa, 4= carbúnculo sintomático, 5= tabardillo (v), 6= peste porcina (p), 7= parasitosis (o), 8= diarrea (g), 9=otro

8c. Que método se usa para combatir?_____
1= vacunas, 2= medicamentos, 3= antibióticos , 4= yerbas, 5=otro

8d. Hoy en día hay mas enfermedades que hace 10 años? _____ 1=Sí, 2=No

8e. Si hay mas enfermedades ahora que antes, que efecto tiene? _____
1= menos ganado, 2= mas vacunas, 3= ingresos disminuidos, 4= carnear antes, 5= otro

8f. En los últimos 10 años se han visto un cambio de la composición del ganado?
_____ 1= Sí, 2=No

8g. Que cambios se han visto y porque?_____

_____

8h. Ud. lleva su ganado a que mercados / ferias (cuantas veces) o los vende aquí a transportistas?_____ 1= mercado / feria, 2= transportista

9. Medios de producción para la ganadería:

					Compra / alquiler				Mantenimiento		
No	Tipo	Adquisición	cantidad	Frecuencia de uso	fecha	lugar	precio	financiamiento	frecuencia	costo	vida útil
1	Forraje										
2	Maíz										
3	Alquiler pradera										
4	Vacunas rabia/ fiebre aftosa										
5	Deparasitante										
6	Sal										
7	Vitaminas										
8	Cencerro										
9	Jornales de peones		días								
10	Reconstituyente										
11	Lazos										
12	Cura Vichera										
13	Mineralizante Vitamina										
14	otros										

Adquisición: 1= insumo, 2= comprado, 3= fabricado, 4= intercambiado, 5= alquiler, 6= prestado, 7= otro
Frecuencia: 1= cada día, 2= una vez por la semana, 3= una vez por mes, 4= cada 6 meses, 5= en la época de invierno, 6= en la época de verano (sequía), 7= otro
Financiamiento: 1= a plazo, 2= al prestado, 3= al contado 4= otro

10. Pesca y Caza:

	Venta			Compra				Autoconsumo		
Tipo	cantidad	precio	lugar	lugar	fecha	cantidad	precio	cantidad alimentación familial	cantidad como insumo	del insumo producto obtenido

Tipo: 1= acutí, 2=corzuela, 3=anta, 4=chancho de monte, 5=pavas, 6=dorado, 7= sábalo, 8=churuma, 9= dentón, 10=llausa, 11=robal, 12=miscincho, 13= otro

10a. Se intercambian peces o animales silvestres dentro de la comunidad _____ o con otras comunidades y por cual motivo? _____ 1=Sí, 2=No

11. Aprovechamiento forestal:

		Venta			Autoconsumo	
No	Tipo	Cantidad	Precio	Lugar	Cantidad	Uso
1						
2						
3						
4						
5						
6						

Tipo: 1=Cedro (2), 2=Nogal, 3=Pino, 4= Arrayán, 5=Quina, 6=Lapacho (2), 7=Roble, 8= Aliso, 9=Tusca (5), 10=Cebil (5), 11=Milcaran (5), 12=otro
Uso: 1= construcción de viviendas, 2= muebles, 3= constr. de herramientas, 4= infraestructura productiva, 5= leña, 6= carbón, 7= carpintería, 8=otro

12. Otros productos:

		Autoconsumo			Venta			Compra			
No	Tipo	cantidad	usado como insumo	insumo producto obtenido	cantidad	precio	lugar	lugar	fecha	cantidad	precio
1	Canasteria										
2	Frutos										
3	Bejucos										
4	Raíces										
5	Planta medicinal										
6	Nueces										
7	Adobe										
8	Teja (corteza)										
9	otros										

12a. Se intercambian productos dentro de la comunidad _____ o con otras comunidades? _____ 1=Sí, 2=No

13. Infraestructura:

						Mantenimiento			
No	Tipo	cantidad	Costo total	adquisición	fecha	costo	frecuencia	Días de trabajo por familia	Vida útil
1									
2									
3									
4									
5									
6									

Tipo: 1= silo (zarzo), 2= trapiche, 3= corral, 4= otro
Adquisición: 1= insumo, 2= comprado, 3= fabricado, 4= intercambiado, 5= alquiler, 6= prestado, 7= otro

14. Percepciones sobre impacto de ganadería trashumante:

1. En los últimos 10 años se han cambiado el clima?_____ 1=Sí, 2=No
2. Que tipo de cambios de clima ocurre en la comunidad y cual son las consecuencias? _____
   1= sequia, 2= riadas, 3= helada, 4= granizada, 5= viento, 6= mas lluvia, 7= otro
3. En los últimos 10 años se han cambiado la calidad y cantidad de los recursos naturales?

agua: _____ 1=Peor, 2=Igual, 3= Mejor
suelo:_____ 1=Peor, 2=Igual, 3= Mejor
forraje: _____ 1=Peor, 2=Igual, 3= Mejor
animales:_____ 1=Peor, 2=Igual, 3= Mejor
vegetación: _____ 1=Peor, 2=Igual, 3= Mejor
otro:_____ 1=Peor, 2=Igual, 3= Mejor

4. Que tipo de problemas y cambios se puede observar? _____
   1= sobrepastoreo, 2= mas helecho macho, 3= mas enfermedades en el ganado, 4= mas erosión, 5= menos rendimientos, 6= otro
5. Cuál problema les afecta mas y cual menos ? Más= _____, Menos= _____
6. ¿Cuánto ganado se encuentra en la cercanía de su comunidad / en los pastoreos de su comunidad en invierno / en verano? Invierno_____, Verano_____
7. ¿Cuánto ganado llega del Valle Central en los pastoreos de su comunidad?

_____

8. Cuánto ganado se encuentra dentro de su comunidad?_____
9. Se ha cambiado la cantidad de ganado trashumante recibido en los últimos 10 años? Se ha (1=) aumentado o (2=) disminuido?_____
10. Por cuanto más o menos se ha aumentado / disminuido en los últimos 10 años?

_____

11. El ganado del Valle Central causa problemas para Ud.? _____ 1=Sí, 2=No,
12. Que tipo de problemas causa?

_____

13. Hoy hay mas problemas que hace 10 años? _____ 1Sí, 2=No
14. Cómo les afectan estos problemas? Se tiene que llevar el ganado mas lejos?? Tienen que usar tierras distintas por la cultivación? Afecta los caminos? Llevan enfermedades?

_____

_____

Annex III: Examples of Gross Margin Calculations

Table 1. Gross Margin calculation for maize enterprise:

			Gross Output (GO)					Variable Costs (VC): Material						VC: Machinery		VC: Hired Labour		VC:		
	Household	Unit	Maize yield	Sales price (Bs/c)	GO (Bs)	GO ($)	has sown	Seed	Fertilizer	Fungicides	Herbicides	Insecticides	Rent tractor	Rent bullocks	Labour	Labour irrigation	Imputed Interest	Total VC	Gross Margin (Bs)
PUESTO RUEDA	1	cargas	60	53	3180	512.90	2	0	0	0	0	0	0	60	900		34	994	2186
	2	cargas	100	53	5300	854.84	1.75	0	0	0	0	0	0	100	1320		50	1470	3830
	3	cargas	90	53	4770	769.35	2	0	0	0	0	0	0	0	0		0	0	4770
	4	cargas	15	53	795	128.23	0.75	0	0	0	0	0	0	0	315		11	326	469
	5	cargas	31	53	1643	265.00	1.75	0	0	0	0	0	0	100	225		11	336	1307
	6	cargas	28	53	1484	239.35	1	0	0	0	0	0	0	60	300		13	373	1111
	7	cargas	70	53	3710	598.39	2	0	0	0	0	0	0	0	1600		56	1656	2054
	8	cargas	37	53	1961	316.29	2.5	0	0	0	0	0	0	0	300		11	311	1651
	9	cargas	6	53	318	51.29	0.25	0	0	0	0	0	0	0	0		0	0	318
	10	cargas	53	53	2809	453.06	2.5	0	0	0	0	0	0	0	600		21	621	2188
	11	cargas	40	53	2120	341.94	1	0	0	0	0	0	0	60	225		10	295	1825
	12	cargas	20	53	1060	170.97	0.75	0	0	0	0	0	0	0	270		9	279	781
	13	cargas	30	53	1590	256.45	1.5	0	0	0	0	0	0	0	600		21	621	969
	14	cargas	25	53	1325	213.71	0.5	0	0	0	0	0	0	0	300		11	311	1015
	15	cargas	45	53	2385	384.68	1.25	0	0	0	0	0	0	120	900		36	1056	1329
	Average		43.33	53.00	2297	370.43	1.43	0	0	0	0	0	0	83.33	604.23		19	707	1720
CHOCLOCA	1	cargas	20	60	1200	193.55	1	20	88.8	0	40	25	108	0	300	120	25	726	474
	2	cargas	46	55	2530	408.06	3	625	75	0	4	90	198	0	875	360	78	2305	225
	3	cargas	30	53	1590	256.45	2	0	217.5	0	0	70	378	0	625	240	54	1584	6
	4	cargas	10	53	530	85.48	2	0	108.75	0	70	70	300	0	250	240	36	1075	-545
	5	cargas	40	53	2120	341.94	1.75	0	188.5	0	40	100	192	0	375	210	39	1144	976
	6	cargas	20	53	1060	170.97	1	0	108.75	0	80	80	0	0	325	120	25	739	321
	7	cargas	20	45	900	145.16	1	72	181.25	0	72	0	54	0	250	120	26	775	125
	8	cargas	30	53	1590	256.45	2.5	0	253.75	0	6	0	228	0	750	300	54	1592	-2
	9	cargas	20	53	1060	170.97	1	0	239.25	0	7	0	40.5	0	300	120	25	731	329
	10	cargas	15	53	795	128.23	1	0	280	0	60	225	480	0	125	120	45	1335	-540
	11	cargas	27	53	1431	230.81	1	0	159.5	0	0	50	216	25	300	120	30	901	530
	12	cargas	20	53	1060	170.97	2	0	116	0	8	90	108	0	375	240	33	970	90
	13	cargas	30	53	1590	256.45	1	0	362.5	0	0	80	456	0	225	120	44	1287	303
	14	cargas	40	53	2120	341.94	1	40	108.75	0	0	60	0	0	200	120	19	547	1573
	15	cargas	50	65	3250	524.19	3	54	725	0	56	50	324	125	625	360	81	2400	850
	Average		27.87	53.87	1521.73	245.44	1.62	162.2	214.22	0	37.77	84.43	239.76	75	393.33	194.00	41	1442	314

Source: own survey

Table 2. Gross Margin calculation for 'criollo' cattle enterprise

		Gross Output (GO): Sales			GO: Home consumption			Variable Costs (VC): Material				VC: Hired Labour		VC:	VC: Depreciation		VC:		
	Household	Cows	Bullock	Meat	Cows	Milk	GO (Bs.)	Vaccination	Dep, rec & cur	Cura vichera	Salt	Taking cows to Tariquia	Looking after cows	Risk of loss	Cow	Bullock	Imputed interest	Total VC	Gross Margin (Bs)
PUESTO RUEDA	1	1000			2000	1056	4056	125	100	32	24			3000	367		306	3954	102
	2	2400			1000	2688	6088	330	231	16	24			4200	933	257	809	6800	-712
	3						0	12	0	0	0			0	0		25	37	-37
	4																		
	5				1000	1440	2440	150	90	16	24			0	500		368	1148	1293
	6						0	10	0	0	12			1200	67		25	1313	-1313
	7	1200		1400	3000	1440	7040	205	205	32	24			1200	500	86	502	2754	4286
	8	1300			1000	672	2972	65	65	16	0			0	233	86	159	624	2348
	9																		
	10	2000			2000	1056	5056	125	38	0	24	100		600	367		306	1559	3497
	11				1000	1920	2920	0	0	0	24			0	667		355	1046	1874
	12						0	0	0	0	12			0	33		25	70	-70
	13					1440	1440	120	104	0	12			1200	500	86	490	2512	-1072
	14																		
	15				1000	864	1864	90	45	16	24			600	300		221	1296	569
	Average	1596	0	1400	1500	1397	5893	103	73	11	17	100		1000	372	129	299	1926	897
CHOCLOCA	1	3600	4000	2000	10000	4320	23920	516		28	24	925	0	2400	1500	171	1054	6618	17302
	2	2400				2688	5088	702	1836	28	12	500	500	600	933	171	662	5944	-856
	3	2400	2200			1248	5848	276		28	24	500	480	1800	433	86	282	3909	1939
	4		5600		1000	1152	7752	280		28	24	375	360	0	400	86	343	1896	5856
	5					384	384	104		14	12	250	135	0	133	171	159	979	-595
	6	2000				1056	3056	297	540	28	24	400	285	600	367	86	331	2957	99
	7	2000				768	2768	116		28	24	200	225	0	267	86	257	1202	1566
	8	1200	6000	500	1000	1824	10524	220		28	24	400	0	1800	633	86	490	3681	6843
	9	2000				672	2672	126	1470	15	12	500	255	0	233	171	257	3040	-368
	10					1152	1152	360		28	36		300	0	400	86	368	1577	-425
	11	4800	7500	500	1000	2496	16296	180	180	42	24	500	645	1800	867	86	735	5058	11238
	12	3600	6600	4000		1536	15736	222	481	42	36	500	0	0	533	171	453	2439	13297
	13	1000				1056	2056	140		28	24	400	360	2400	367	86	343	4147	-2091
	14	2000	2000		1000	3168	8168	525	56	42	24		810	1200	1100	86	858	4700	3468
	15	1200	2000			1056	4256	156		28	24	300	100	1200	367	86	319	2579	1677
	Average	2350	4488	1750	2800	1638	13026	281	761	29	23	442	297	13935	569	114	461	3382	3930

Source: own survey

Annex IV: Miscellaneous Tables

Table 1. Comparison of labour days necessary for maize production on the slopes and plains in Puesto Rueda

Maize cultivation on the slopes (1 ha)			**Maize cultivation in the plains (1ha)**		
	Task	Time needed (days)		Task	Time needed (days)
1	Clearing	~ 22	1	Prepare terrain	8
2	Fencing	8	2	Sowing	32
3	Sowing	10	3	Weeding	14
4	Weeding	16	4	Earthing up	4
5	Harvesting	24	5	Harvesting	8
	Total	**80**		**Total**	**66**

Source: PROMETA, 1998a

Table 2. TLU Conversion Table

In order to be able to compare and analyse the livestock enterprises, a conversion factor needs to be applied, which gives a weight to each species on the basis of the base unit of a cow. This TLU conversion factor has been calculated consulting the following literature: JAHNKE (1982:10); QUIROS (2000:228); GITTINGER (1984:174); ANDREAE (1964:411)

Base unit: 250kg cow

Species	Conversion Factor
Cow	1.0
Oxen	1.2
Bullock	1.2
Heifer <1yr	0.3
Heifer > 1yr	0.7
Pig	0.2
Piglet	0.1
Sheep & Goat	0,1
Lamb & Kids	0,05
Chicken	0,01
Horse	1,0
Donkey	0,3
Mule	0,3

Annex V: Complete Tables of Gross Margin Analysis

Table 1. Scale of farming – Hectare size and Productivity of each crop enterprise

			Hectare size (ha)					Productivity (GO/ha in Bs.)				
	PR	C	PR	C	PR	C	t-test	PR	C	PR	C	t-test
	N	N	Mean	Mean	Std. Dev	Std. Dev	t	Mean	Mean	Std. Dev	Std. Dev	t
Maize	15	15	**1.43**	**1.62**	0.71	0.76	**-0.682**	**1,645**	**1,035**	667	454	**2.930****
Potato	10	15	**0.17**	**0.60**	0.13	0.31	**-4.096*****	**1,320**	**4,543**	820	2,654	**-3.702*****
Peanuts	7	5	**0.11**	**0.20**	0.08	0.07	**-2.043***	**3822**	**8,824**	1,330	6,638	**-1.976***
Onions	12	9	**0.06**	**0.22**	0.03	0.21	**-2.573****	**590**	**2,618**	116	1,462	**-4.827*****
Peas	8	9	**0.04**	**0.28**	0.04	0.30	**-2.280****	**2,843**	**1,566**	1,557	1,261	**1.867***
Sweet potato	4	1	**0.06**	**0.13**	0.04	0	**-1.291**	**1,854**	**960**	2,608	0	**0.307**
Snap beans	2	4	**0.31**	**0.22**	0.27	0.19	**0.516**	**2,090**	**6,515**	2,418	2,320	**-2.179***
Horse beans	1	1	**0.02**	**0.25**	0	0	**0**	**10**	**80**	0	0	**0**
String beans	0	3		**0.11**		0.12			**2,986**		1,628	
Vine	0	6		**0.33**		0.13			***11,383***		7,428	
Tomato	0	7		**0.20**		0.16			***12,400***		14,251	
Pumpkin	0	4		**0.10**		0.11			***12,650***		5,716	
Yuca	11	0	**0.07**		0.08			**2,815**		1,261		
Ajipa	2	0	**0.01**		0.01			***17,200***		1,697		
Wheat	1	0	**0.25**		0			**5,520**		0		
Soya	1	0	**0.13**		0			**1,488**		0		
Tobacco	1	0	**0.01**		0			**875**		0		
Peaches	14	15	**12**	**37**	10.21	59.56	**-1.578**	**12**	**11**	2.11	0.95	**1.47**
Oranges	14	1	**16**	**2**	26.80	0	**0.492**	**10**	**16**	0	0	**0**
Figs	0	15		**5**		2.39			**110**		0	

*** significant at 1% level, ** significant at 5% level, * significant at 10% level - Enterprises present in both villages are printed in bold

Source: own survey

Table 2. Profitability, Capital Efficiency and Productivity – Crop enterprises

			Profitability (GM/ha; in Bs.)					Capital Efficiency (VC/GO)					Capital Productivity (GM/VC)				
	PR	C	PR	C	PR	C	t-test	PR	C	PR	C	t-test	PR	C	PR	C	t-test
	N	N	Mean	Mean	Std. Dev	Std. Dev	t	Mean	Mean	Std. Dev	Std. Dev	t	Mean	Mean	Std. Dev	Std. Dev	t
Maize	15	15	**1,239**	**254**	584	470	**5.091*** **	**0.25**	**0.89**	0.14	0.44	**-5.362*** **	**.94**	**0.39**	1.53	0.78	**5.676*** **
Potato	10	15	**1,072**	**2,096**	595	2,565	**-1.232**	**0.14**	**0.68**	0.19	0.39	**-4.076*** **	**3.56**	**1.01**	2.57	1.30	**2.973*** **
Peanuts	7	5	**3,811**	**7,830**	1,333	6,466	**-1.627**	**0**	**0.15**	0	0.09	**-4.272*** **	**42.48**	**7.76**	.	4.89	**6.479*** **
Onions	12	9	**536**	**1,459**	73	1,513	**-2.129** **	**0.07**	**0.69**	0.14	0.56	**-3.695*** **	**3.03**	**1.49**	2.13	1.68	**1.295**
Peas	8	9	**2,804**	**507**	1,527	725	**4.041*** **	**0.01**	**2.56**	0.02	5.53	**-1.299**	**22.19**	**0.38**	8.20	0.69	**9.928*** **
Sweet potato	4	1	**1,854**	**836**	2,608	.	**0.349**	**0**	**0.13**	0	0	**0**		**6.73**		.	
Snap beans	2	4	**2,090**	**5,915**	2,418	2,451	**-1.808**	**0**	**0.11**	0	0.06	**-2.167***		**23.05**		32.95	
Horse beans	1	1	**10**	**-123**	.	.	.	**0**	**2.54**	0	0	**0**		**-0.61**		.	
String beans	0	3		**1147**		792			**0.69**		.8591						
Vine	0	6		**10158**		7249			**0.15**		.1067			**7.89**		4.42	
Tomato	0	7		**9553**		13196			**0.33**		.2451			**5.03**		7.03	
Pumpkin	0	4		**8269**		4550			**0.35**		.2037			**2.94**		2.59	
Yuca	11	0	**2815**		1261			**.00**		.0000							
Ajipa	2	0	**17200**		1697			**.00**		.0000			**13.49**		.		
Wheat	1	0	**5139**		.			**0.07**		,			**2.59**		.		
Soya	1	0	**1074**		.			**0.28**		,							
Tobacco	1	0	**875**		.			**.00**		,							
Peaches	14	15	**12**	**6**	2.11	3.36	**4.988*** **	**0**	**0.40**	0	0.30	**-4.917*** **		**2.00**		1.75	
Oranges	14	1	**10**	**16**	0	0	**0**	**0**	**0**	0	,	.					
Figs	0	15		**110**		,00			**0**		0						

*** significant at 1% level, ** significant at 5% level, * significant at 10% level - Enterprises present in both villages are printed in bold

Source: own survey

Table 3. Scale of farming – livestock numbers kept by households

	PR	C	PR	C	PR	C	T-Test
	N	**N**	**Mean**	**Mean**	**Std. Dev**	**Std. Dev**	**t**
Criollo cattle	12	15	**24.42**	**37.60**	19.02	20.75	**-1.701 (10%)**
Holstein cattle	0	11		**6.64**		1.69	
Pigs	11	11	**10.18**	**4.18**	7.08	2.48	**2.651****
Sheep	12	5	**16.33**	**7.60**	9.37	5.68	**1.920***
Goats	0	4		**22.75**	20.26		
Poultry	15	13	**25.87**	**10.00**	13.05	3.81	**4.222*****

*** significant at 1% level, ** significant at 5% level, * significant at 10% level
[a] Tropical Livestock Unit, see Annex IV for explanation

Source: own survey

Table 4. Gross Output, Variable Cost and Gross Margin per animal

			Productivity (GO/animal; in Bs.)					Variable Costs per animal (Bs.)					Profitability (GM/animal; in Bs.)				
	PR	C	PR	C	PR	C	T-test	PR	C	PR	C	T-test	PR	C	PR	C	T-test
	N	**N**	**Mean**	**Mean**	**Std. Dev**	**Std. Dev**	**t**	**Mean**	**Mean**	**Std. Dev**	**Std. Dev**	**t**	**Mean**	**Mean**	**Std. Dev**	**Std. Dev**	**t**
Criollo cattle	12	15	**98**	**177**	80.05	111.84	**-2.056****	**113**	**95**	175.25	35.67	**0.397**	**-15**	**82**	213.61	120.49	**-1.495 (14%)**
Holstein	0	11		**2,293**		1,151			**1,484**		492.17			**810**		854.61	
Pigs	11	11	**137**	**230**	151.78	111.13	**-1.640 (11%)**	**8**	**9**	2.12	4.06	**-0.988**	**129**	**220**	151.53	108.18	**-1.628 (12%)**
Sheep	12	5	**12**	**45**	11.65	28.89	**-3.456*****	**7**	**7**	2.11	3.67	**-0.358**	**6**	**38**	13.09	29.98	**-3.186*****
Goats	0	4		**13**		13.76			**11**		2.52			**2**		11.65	
Poultry	15	13	**55**	**42**	45.93	13.78	**0.940**	**3**	**4**	.6209	0.57	**-0.272**	**51**	**39**	46.13	14.06	**0.943**

*** significant at 1% level, ** significant at 5% level, * significant at 10% level
Source: own survey

Table 5. Comparison of Capital Efficiency: VC inclusive of all items and VC II (only cash expenses) - Livestock

			Capital Efficiency (VC/GO)					Capital Efficiency II (VC II/GO)					Capital Productivity (GM/FC)				
	PR	C	PR	C	PR	C	T-test	PR	C	PR	C	T-test	PR	C	PR	C	T-test
	N	**N**	**Mean**	**Mean**	**Std. Dev**	**Std. Dev**	**t**	**Mean**	**Mean**	**Std. Dev**	**Std. Dev**	**t**	**Mean**	**Mean**	**Std. Dev**	**Std. Dev**	**t**
Criollo cattle	12	15	**0.52**	**0.86**	0.53	0.70	**-1.370 (18%)**	**0.08**	**0.38**	0.04	0.37	**-2.400****	**-0.02**	**0.09**	0.22	0.13	**-1.591(12%)**
Holstein	0	11		**0.72**		0.27			**0.62**		0.27			**0.19**		0.19	
Pigs	11	11	**0.11**	**0.07**	0.11	0.09	**0.966**	**0.01**	**0.01**	0.02	0.02	**-0.176**	**0.94**	**1.28**	1.34	0.61	**-0.759**
Sheep	12	5	**1.23**	**0.11**	1.55	0.10	**1.570 (13%)**	**0.02**	**0.02**	0.04	0.02	**-0.074**	**0.13**	**0.67**	0.32	0.56	**-2.530****
Goats	0	4		**0.80**		0.86			**0.03**		0.06			**0.02**		0.16	
Poultry	15	13	**0.09**	**0.09**	0.05	0.04	**-0.179**	**0**	**0**	0.02	0.01	**0.116**	**2.57**	**2.59**	2.31	0.92	**-0.029**

*** significant at 1% level, ** significant at 5% level, * significant at 10% level
Source: own survey

Table 6. Scale of farming – Total numbers

	PR	C	PR	C	PR	C	T-Test
	N	**N**	**Mean**	**Mean**	**Std. Dev**	**Std. Dev**	**t**
Total cultivated area (ha)	15	15	**1.90**	**3.20**	0.91	1.22	**-3.306*** **
No of different livestock species	15	15	**3.33**	**3.93**	0.98	1.03	**-1.635 (11%)**
Av. TLU size	15	15	**18.75**	**37.83**	17.62	17.43	**-2.982 *** **

*** significant at 1% level, ** significant at 5% level, * significant at 10% level
Source: own survey

Table 7. Total Productivity, Variable Costs and Profitability

			Productivity (GO; in Bs.)					**Variable Costs (Bs.)**					**Profitability (GM ; in Bs.)**				
	PR	C	PR	C	PR	C	T-test	PR	C	PR	C	T-test	PR	C	PR	C	T-test
	N	**N**	**Mean**	**Mean**	**Std. Dev**	**Std. Dev**	**t**	**Mean**	**Mean**	**Std. Dev**	**Std. Dev**	**t**	**Mean**	**Mean**	**Std. Dev**	**Std. Dev**	**t**
Crops	15	15	3,458	12,179	2,071	7,475	**-4.355*** **	**610**	**4,764**	540	1,964	**-7.897**	**2,848**	**7,415**	1,733	6,097	**-2.791*** **
Livestock	15	15	4,275	19,174	3,609	10,336	**-5.270*** **	**1,787**	**10,664**	1,965	5,274	**-6.108**	**2,489**	**8,510**	2,685	8,238	**-2.691** **
Total	15	15	7,733	31,352	5,242	14,349	**-5.988*** **	**2,397**	**15,428**	2,447	6,012	**-7.776**	**5,336**	**15,925**	3,551	12,081	**-3.257*** **

*** significant at 1% level, ** significant at 5% level, * significant at 10% level
Source: own survey

Table 8. Total Capital Efficiency

	PR	C	PR	C	PR	C	T-test
	N	**N**	**Mean**	**Mean**	**St Dev**	**St Dev**	**t**
Crops	15	15	**0.17**	**0.48**	0.09	.2785	**-4.049*** **
Livestock	15	15	**0.42**	**0.62**	.3705	.2532	**-1.714***
Total	15	15	**0.28**	**0.54**	.1902	.1842	**-3.823*** **

*** significant at 1% level, ** significant at 5% level, * significant at 10% level
Source: own survey

Table 9. Total Farm Profitability and Land Use Productivity

	PR	C	PR	C	PR	C	t-test
	N	**N**	**Mean**	**Mean**	**St Dev**	**St Dev**	**T**
Total Net Farm Income (Bs.)	15	15	**5,115**	**15,040**	348	12.05	**-3.064*** **
Total Net Farm Income US$ (per month)	15	15	**812 (68)**	**2,387 (199)**	553	1913	**-3.064*** **
Net farm income/ha of tot farm land	15	15	**2,814**	**4,841**	1377	3476	**-2.100** **

*** significant at 1% level, ** significant at 5% level, * significant at 10% level
Data: own survey

Annex VI. Complete Tables of Indicator Conversion and Cross-tab Results

Table 1. Conversion Table of range of household results into productive performance categories

Variable	Performance Category	Low	Middle	High
	Ranking / Indicator	1	2	3
Scale of farming	Total ha	0.25 – 2.15	>2.15 – 4.05	>4.05 – 6
	Total TLU	0.02 – 27	> 27 – 54	>54 – 81
Productivity	Total GO (Bs.)	1,390 – 20,467	> 20,467 – 39,544	> 39,544 – 58,622
Profitability	Total GM (Bs.)	1,384 – 14,436	>14,436 – 27,488	> 27,488 – 40,541
	Net Farm Income (Bs.)	1,268 – 14,138	>14,138 – 27,008	>27,008 – 39,878
Resource usage in farming	GO/VC	0 – 0.28	0.28 – 0.55	> 0.55 – 0.83
	NFY/ha	545 – 4,525	>4,525 – 8,505	8,505 – 12,485

Source: own survey

Table 2. Cross-tab Results with Chi-Square values and significance levels of performance indicators

Variable	Indicator	Performance Category						Significant difference
		Low		Middle		High		Chi-Square Value[a]
		PR (N=15)	C (N=15)	PR (N=15)	C (N=15)	PR (N=15)	C (N=15)	
Scale of farming	Total ha	60%	20%	40%	67%	0%	13%	6.000**
	Total TLU	80%	33%	13%	47%	7%	20%	6.660**
Productivity	Total GO	100%	27%	0%	40%	0%	33%	17.369***
Profitability	Total GM	100%	60%	0%	20%	0%	20%	7.500**
	Net Farm Income (NFY)	100%	60%	0%	20%	0%	20%	7.500**
Resource usage in farming	GO/VC	67%	7%	27%	33%	7%	60%	13.875***
	NFY/ha	87%	53%	13%	27%	0%	20%	4.857*

*** significant at 1% level, ** significant at 5% level, * significant at 10% level

[a] Due to small sample sizes (N=15), the sample statistic may not approximate the theoretical Chi-Square distribution very closely. However, as the sample size is given, the results will be accepted, with the notion in mind, that they might not completely portray the truth, but give at least an indication.

Source: own survey

Table 3. Conversion Table for Crop and Livestock Diversification Indicator Categories

Diversification category	Diversification ranking	No of crops/trees	No of livestock species
Low	1	5 – 8	1 – 3
Middle	2	9 - 12	4 – 6
High	3	13 - 16	7 – 9

Source: own survey

Table 4. Conversion Table for Crop and Livestock Function Diversification Indicator Categories

Diversification category	Diversification ranking	Mix of crop functions	Mix of livestock functions
Low	1	BC + FT	SH SH + LH
Middle	2	BC + FT + FC BC + FT + CC	SH + LH + DA SH + LH + TA SH + LH + CA + DA SH + LH + DA + TA
High	3	BC + FT + CC + FC	SH + LH + CA + DA + TA

BC= Basic Crops; CC= Cash Crops; FC= Fodder Crops; FT= Fruit Trees
SH= Small Home; LH= Large Home; CA= Cash; DA= Draught and TA= Transport Animal
Source: own survey

Table 5. Conversion Table Livelihood Diversification Indicator Categories

Diversification category	Diversification ranking	Non-agricultural activities	Non-monetary exchange
Non	0	no use	no exchange
Low	1	only SM only FH only TE	only SC only LS
High	3	FH & TE SM & FH & TE	SC & LS

SM= simple manufacturing; FH= fishing and hunting; TE= timber extraction
SC= seeds and crops; LS= livestock and animal products
Source: own survey

Table 6. Cross-tab results with Chi-Square values and significance levels of all working variables

Variable	Performance Category								Significant difference
	No		Low		Middle		High		Chi-Square Value[a]
	PR (N=15)	C (N=15)	PR (N=15)	C (N=15)	PR (N=15)	C (N=15)	PR (N=15)	C (N=15)	
1. Scale of farming			60%	13%	33%	67%	7%	20%	7.12**
2. Productivity			100%	27%	0%	40%	0%	33%	17.368***
3. Profitability			100%	60%	0%	20%	0%	20%	7.500**
4. Resource usage in farming			53%	0%	47%	73%	0%	27%	12.889***
5. On-farm Diversification			40%	20%	53%	20%	7%	60%	9.673***
6. Livelihood Diversification	0%	13%	20%	67%	53%	20%	27%	0%	12.042***
7. Migration	13%	27%	0%	0%	0%	0%	87%	73%	0.833

*** significant at 1% level, ** significant at 5% level, * significant at 10% level

[a] Due to small sample sizes (N=15), the sample statistic may not approximate the theoretical Chi-Square distribution very closely. However, as the sample size is given, the results will be accepted, with the notion in mind, that they might not completely portray the truth, but at least give an indication.

Source: own survey

Table 7. Cross-tab results of main variables production performance and livelihood diversification

		production performance			Total
		low	middle	high	
Puesto Rueda	Count	14	1	0	15
	Expected Count	8.5	4.5	2.0	15.0
	%	93.3%	6.7%	0%	100%
Chocloca	Count	3	8	4	15
	Expected Count	8.5	4.5	2.0	15.0
	%	20.0%	53.3%	26.7%	100.0%
Total	Count	17	9	4	30
	Expected Count	17.0	9.0	4.0	30.0
	%	56.7%	30.0%	13.3%	100.0%
		livelihood diversification			Total
		low	middle	high	
Puesto Rueda	Count	1	5	9	15
	Expected Count	2.0	5.0	8.0	15.0
	%	6.7%	33.3%	60.0%	100.0%
Chocloca	Count	3	5	7	15
	Expected Count	2.0	5.0	8.0	15.0
	%	20.0%	33.3%	46.7%	100.0%
Total	Count	4	10	16	30
	Expected Count	4.0	10.0	16.0	30.0
	%	13.3%	33.3%	53.3%	100.0%

Source: own survey

Table 8. Cross-tab results of relationship between Production Performance and Livelihood strategy diversification

			livelihood diversification			Total
			low	middle	high	
Puesto Rueda: production performance	low	Count	1	5	8	14
		Expected Count	.9	4.7	8.4	14.0
		% within production performance	7.1%	35.7%	57.1%	100.0%
	middle	Count	0	0	1	1
		Expected Count	.1	.3	.6	1.0
		% within production performance	.0%	.0%	100.0%	100.0%
	Total	Count	1	5	9	15
		Expected Count	1.0	5.0	9.0	15.0
		% within production performance	6.7%	33.3%	60.0%	100.0%
Chocloca: production performance	low	Count	1	0	2	3
		Expected Count	.6	1.0	1.4	3.0
		% within production performance	33.3%	.0%	66.7%	100.0%
	middle	Count	1	5	2	8
		Expected Count	1.6	2.7	3.7	8.0
		% within production performance	12.5%	62.5%	25.0%	100.0%
	high	Count	1	0	3	4
		Expected Count	.8	1.3	1.9	4.0
		% within production performance	25.0%	.0%	75.0%	100.0%
	Total	Count	3	5	7	15
		Expected Count	3.0	5.0	7.0	15.0
		% within production performance	20.0%	33.3%	46.7%	100.0%

Source: own survey

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