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FIELD RESEARCH ON TRANSPORTATION COSTS, FARM-GATE, AND FARMER MARKET PRICES IN THE ATLANTIC ZONE OF COSTA RICA

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CENTRO AGRONOMICO TROPICAL DE
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The Research Program on Sustainability in Agriculture (REPOSA) is a cooperation between Wageningen Agricultural University (WAU), the Center for Research and Education in Tropical Agriculture (CATIE), and the Costa Rican Ministry of Agriculture and Livestock (MAG). In addition, REPOSA has signed memoranda of understanding with numerous academic, governmental, international, and non-governmental organizations in Costa Rica.
The overall objective of REPOSA is the development of an interdisciplinary methodology for land use evaluation at various levels of aggregation. The methodology, based on a modular approach to the integration of different models and data bases, is denominated *USTED* (*Uso Sostenible de Tierras En el Desarrollo*; Sustainable Land Use in Development).
REPOSA provides research and practical training facilities for students from WAU as well as from other Dutch and regional educational institutions.
REPOSA's research results are actively disseminated through scientific publications, internal reports, students' thesis, and presentations at national and international conferences and symposia. Demonstrations are conducted regularly to familiarize interested researchers and organizations from both within and outside Costa Rica with the *USTED* methodology.
REPOSA is financed entirely by WAU under its Sustainable Land Use in the Tropics program, sub-program Sustainable Land Use in Central America. It operates mainly out of Guápiles where it is located on the experimental station *Los Diamantes* of MAG.

REPOSA (*Research Program on Sustainability in Agriculture*, o sea Programa de Investigación sobre la Sostenibilidad en la Agricultura) es una cooperación entre la Universidad Agrícola de Wageningen, Holanda (UAW), el Centro Agronómico Trópical de Investigación y Enseñanza (CATIE) y el Ministerio de Agricultura y Ganadería de Costa Rica (MAG). Además REPOSA ha firmado cartas de entendimiento con organizaciones académicas, gubernamentales, internacionales y non-gubernamentales en Costa Rica.

REPOSA ha desarrollado una metodología cuantitativa para el análisis del uso sostenible de la tierra para apoyar la toma de decisiones a nivel regional. Esta metodología, llamada USTED (Uso Sostenible de Tierras En el Desarollo) involucra dimensiones económicas y ecológicas, incluyendo aspectos edafológicos y agronómicos.

REPOSA ofrece facilidades para investigaciones y enseñanza para estudiantes tanto de la UAW, como de otras institutiones educacionales holandesas y regionales.

REPOSA publica sus resultados en revistas científicas, tesis de grado, informes, y ponencias en conferencias y talleres. REPOSA regularmente organiza demostraciones para investigadores de Costa Rica y de otros países para familiarizarlos con la metodología USTED.

REPOSA es financiado por la UAW bajo su Programa del Uso Sostenible de la Tierra en los Areas Trópicos. La sede de REPOSA está ubicada en la Estación Experimental Los Diamantes del MAG en Guápiles.

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SUMMARY

In summary, this study aims to provide the following outputs;

- Costs of hiring transportation to markets (farmer markets, CENADA), exporters from different parts of the Atlantic Zone.
- Quantitative relation between costs of hiring transport and distance on four road types.
- Output prices of different crops at farm level, specified per economic subregion.
- Price of crops at *feria's del agricultor* in the AZ.
- Relation between farm-gate and prices at CENADA wholesale market.
- Relation between farm-gate and farmer market prices in the Atlantic Zone

1. INTRODUCTION

This study is carried out in the context of REPOSA (Research Program on Sustainability in Agriculture). REPOSA is a interdisciplinary research collaboration between Wageningen Agricultural University, the Tropical Agronomical Research and Higher Education Centre (CATIE) and the Costa Rican Ministry of Agriculture and Livestock (MAG). Main objective of the programme is the development of USTED (*Uso Sostenible de Tierras En el Desarollo*; Sustainable Land Use in Development), a land use and evaluation methodology. En USTED, Land Use Systems at a defined Technology (LUST) describe quantified operation sequences. Each LUST is described in an individual database. Additional information, e.g. prices of inputs and outputs, is stored in so-called attribute databases. The attribute databases adapt easily to changing prices in time or per region. Thus, technical options are separated from socioeconomic conditions (Jansen & Schippper, 1995)

For the required regionalization of the USTED methodology, the quality of the road infrastructure is an important variable due to its influence, among others, on the return from crops and cattle that the farmer may obtain. REPOSA developed USTED at sub-regional d level, under the condition that input and output prices are fixed. Further research now focuses on the up-scaling of the methodology towards the regional level (Stoorvogel *et al*, 1995). This requires information on farm-gate and factor prices at the sub-regional level since it can no longer be expected that these are the same in all sub-regions of the AZ.

In the USTED methodology, the objective function for a linear programming model is maximization of the total net farm income, including household and hired labour and off-farm earnings, for a region or subregion for small and medium size farmers (Schipper, *et al*, 1995). Apart from activity returns, also prices of production factors might differ within the AZ at any moment in time. Production factors include capital, labour and land. Costs of labour and capital are included in the linear programming model and for an update of the model, the labour costs in the first half of 1995 should be incorporated. This study provides information on renting land, interest rates of agricultural credit and on off-farm wages.

The objective of the field research on transportation costs and farm-gate prices for crops is twofold. First, data on transportation costs together with data on geographical distance specified for four road types will be used in regression models to calculate transportation costs of crops and cattle within the AZ and from farm-gate to CENADA wholesale market. The aim of the research on farm-gate prices is to update and geographically differentiate prices of commercial products. Second, the data on geographically differentiated farm-gate prices, in combination with the transportation costs, form the basis for a definition of five economic zones within the AZ. Economic zones are based on the premise that prices at farm-gate level diminish when distance to markets increase. In each economic zone it is assumed that costs of production and farm-gate prices are the same for each farmer. Different databases are defined for output prices of products within each of the economic zones.

2. SURVEY DESIGN AND IMPLEMENTATION

2.1 Background

This study combines data from different sources. Primary data are obtained through three field surveys, i.e. a farm survey, a farmer market survey and a cattle auction survey. The farm survey provides information on transportation costs, farm-gate prices and factor costs. The farmer markets survey provides information on transportation costs, farm-gate prices and farmer markets prices, while the cattle auction survey provides solely data on transportation costs of cattle. Secondary data administered by governmental institutions on prices for agricultural crops are also used. Besides, price information of agricultural products is obtained through farmer cooperatives and exporters operating in the AZ.

2.2 Farm survey design

The farm household, with the family living on or nearby its land, cultivating the land in 1994 and/or 1995, and having sold at least some products or cattle, is chosen as the sample unit of the farm survey. Farm households are chosen non-randomly. Therefore the sample is not a statistical representation of total population of farm households in each of the regions. Consequently, no conclusions can be drawn on the frequency of a certain behaviour. A random sample procedure is not feasible due to lack of complete population data. However, considering the main objective of this study, i.e. estimation of transportation costs of agricultural crops, it is not necessary to work with a perfectly random sample.

The decision making unit, or head of the farm, is preferably chosen as respondent. Excluded are farms managed by caretakers because their knowledge on marketing issues is generally insufficient since they are not responsible for the commercialization of the produce. Furthermore, large plantations ($>$ 50 ha) and large cattle holdings ($>$ 100 ha) are excluded from the survey. Thus, the sample in the farm survey consists of small-and medium-scale farms that practice agriculture, animal husbandry, or both, at small to medium size scale (appendix 1).

Selection of the pilot areas was done in such way as to maximize variation in accessibility of the farm and product occurrence. Areas where banana plantations dominate are excluded because neither transportation costs nor farm-gate price of banana is of direct interest to the REPOSA.

The AZ is divided into five administrative counties or "*cantones*". Each of the counties is further divided in one to six districts. Government officials at local extension offices provided information on the location of specific production areas. Several remarks have to be made regarding the design and execution of the farm survey. These explain the number and quality of valuable interviews that have been administered.

* In the AZ, a large number of people living in rural areas do not sell agricultural produce or cattle at a commercial scale. Three groups can be distinguished. First, there are households that own a plot of land that is too small to cultivate commercially. As a consequence, people primarily earn income out of off-farm labour. Second, there are farm households that own a few ha, but are currently not cultivating or completely stopped cultivating. These families also primarily derive their income from outside their own farm. Thirdly, there is the caretaker, i.e. a family-member or person that looks after a farm that is owned by a different person, often living in Central Valley or in a nearby city. Although the caretaker performs most of the agricultural tasks, he is not involved in the marketing of the crops. Caretakers are found at relatively small farms (< 15 ha) but also at large cattle farms or plantations of, e.g., palm heart, flowers, ornamental plants, cassava and soursop. People working as a caretaker are often told not to cooperate with any study, or lack knowledge regarding the commercialization of the produce. These farms unfortunately had to be excluded from this study, while especially these farms produce and commercialize considerably. Lack of time and resources prevented to search for the owners of these farms.

* It often happens that the head of the farm, is not at home at the time of the survey visit. In such cases no survey form could be completed since the head of the farm is generally the only person with knowledge on marketing issues. The fact that the head of the farm is absent, usually indicates that he is active at work. Consequently, data on active farms are underestimated.

* The head of the farm hesitates or refuses to give information. In the past, numerous representatives of organizations and universities have come to the AZ to gather information. People often are tired cooperating or believe that the research will not be of any benefit to them. As a consequence, people refuse completely to cooperate with the survey or give incomplete answers. Especially heads of prosperous farms refuse to talk. Others are convinced that information will be used for governmental purposes concerning taxes.

The findings of this research are thus greatly influenced by the above mentioned remarks. In other words, especially small-scale farms operating at a low activity level are included in the study, providing a partial overview of the complete array of farming systems in the AZ.

2.3 Farmer market survey design

Farmers that offer their produce at the local farmer markets *(ferias del agricultor)*, were asked about the costs of transporting their products to the farmer market and price differences between farmer market and farm-gate (appendix 2). Farmers at the farmer markets of Limón, Batán, Siquirres, Guápiles, and Cariari were chosen non-randomly. Administrators of the farmers markets were asked to select those farmers that originate from the AZ. The person present at the farmer market is often also the head of the farm.

Local farmer markets are primary meant for farmers from the region, offering their produce directly to the consumer. The objectives of the local farmer markets are to enable farmers to sell at higher prices compared to selling at farm-gate level and to offer high quality fruits and vegetables at relatively low prices to the consumer. Besides local farmers, a number of specialized intermediaries offer products originating from other parts of the country. These external intermediaries are known to dominate supply at the local farmers markets.

2.4 Cattle auction survey design

In the AZ, a cattle auction *(subasta)*, is operating in Guápiles twice a week. Transporters, originating from the AZ were interviewed on the price they charge for transporting animals from different parts of the AZ to the cattle auction (appendix 3). The respondents were mostly the

drivers of the trucks, often accompanied by the owners of the animals.

Many farmers, rather than hiring transport, instead sell their animals at the farm-gate to traders or neighbours that are in the possession of transport means. Three different groups operate at the auction. First, there are large cattle holders that solely transport animals originating from their own farm. Second, there are the small to medium scale cattle holders that occasionally buy animals from other farmers and also hire out space (*flete*) to other farmers or traders, who want to transport their animals. Thirdly, there are the transporters that primarily transport animals of other farmers or traders. Transporters in group two and three are aware of the charges for transporting animals and are included in the sample size. The total population of transporters supplying the auction in Guápiles is fairly stable and the larger part of the total population of cattle transporters active in AZ was interviewed.

3. TRANSPORTATION COSTS

3.1 Background

Transportation costs of agricultural produce for farmers are supposed to be correlated with both distance and type of roads to market centres and therefore with the on farm price of farm inputs and the price a farmer is likely to obtain for his agricultural produce. The quantitative relation between transportation costs per kilometre per road type is investigated in this chapter.

Former studies on infrastructure have focused, on e.g., the relation between infrastructure and agricultural output and investment. Binswanger & Shahidur (1993) developed a model to quantify the relationships between investment decisions of the government, financial institutions and farmers and their joint effects on agricultural investments. Road infrastructure is often represented by road density without further specification for road quality. In the study of .....(19..) (Rural Road Infrastructure in a regional context), road densities are related to the size of the urban sector, food surpluses or deficits, and population densities. The study of von Braun (IFPRI-briefs 3, 1988), concludes that adoption of non-traditional export crops decreases significantly as distance of the farm to the highway increases.

Generally, studies on infrastructure conclude that a relation exists between infrastructure and such development indicators as agricultural output, education, technology adoption etc. However, none of these studies calculate the costs per kilometre and only in a few cases road density is specified per road type. This study however, develops a quantitative relation between transportation costs on the one hand, and distance on four road types and the carrying capacity of the vehicle with which the produce is transported on the other hand. The costs per road type lead to a more subtle differentiation of costs of transport between farm and destination. This study contributes considerably to the knowledge on road infrastructure in relation to costs of transport. The estimation of transportation costs can be deducted from the price at markets from which prices are relatively well known. In this way farm-gate prices can be specified for geographically spread farm locations.

Transportation costs for farmers without private transport facilities in the AZ are defined as the costs of hiring transport facilities. The price of hiring transport facilities is assumed to depend on a number of variables, including:

-1 distance per type of road,

-2 carrying capacity of the vehicle,

-3 relation of the farmer to the owner of the vehicle; if the owner of the vehicle is a relative, or in any other way closely connected to the farmer, a different price (i.e. lower) will be charged,

-4 the number of options open to the farmer when he needs to transport his produce.

In this study, quantitative data on the first and second variable are used to estimate transportation costs. No differentiation is made for cost differences as a result of the third variable since relatively low prices can be considered as normal variation in the costs. Variable four is indirectly correlated with the first variable due to the fact that in areas that are relatively close to the main roads and markets, the number of intermediaries and other buyers is high, increasing the number of options open to the farmer. For that reason, no data on variable four were recorded. Besides distance, also the type of product influences transportation costs. In this study, transportation of crops and cattle are analyzed separately because of the higher risks involved in transporting the latter. Data on agricultural crops do not have to be specified per crop since the type of produce hardly influences the costs of transport. Loaded weight does not seem to influence transport costs since a transporter charges per trip no matter whether the vehicle is loaded at full capacity or not. When farmers report more than one transport arrangement, it is assumed that the observations of a particular population member are independent. Transportation costs are estimated using linear and non-linear models, described in paragraph 3.3.

Transportation costs for farmers with own transport facilities include depreciation, interest, fuel costs, maintenance costs and labor costs. A large difference between the economic costs of owning private transport means and the market price of transportation when a vehicle is hired, indicates a non-competitive environment. In a competitive environment costs of owning private transport should not differ by much from the costs of hiring a vehicle. Even though not done in this study, this hypothesis should be tested.

3.2 Materials and methods

Use is made of data collected in three surveys, i.e. a farm survey, a farmer market survey and a cattle auction survey. From the farm survey, data on the use of transporters (*fleteros*) by farmers is used. A differentiation is made between transportation costs of main farm inputs (e.g. fertilizer) which are transported from agricultural inputs shops to the farm, and transport of farm output which is transported from the farm to the market place. This differentiation is justified for two reasons. First, since in the market centres where input supplies are bought, transporters are generally abundant, a reasonably good competitive environment among transporters exists, in contrast to the situation at the farm-gate level. Second, transporting one to five 50 kilo bags with farm inputs to the farm is different from transporting larger quantities of farm produce to the market since loading and unloading of inputs is considered easier and quicker than loading and unloading of output.

Four road types were distinguished using the GIS (Geographic Information Systems) database of REPOSA which contains information on the road network in the AZ (Stoorvogel & Eppink, 1995). The road network in the AZ covers 2,709 kilometre but only 19.5 % of the roads is paved. The first type of road consists of the main tarmac road from San José to Limón; the second type of road represents are all other tarmac roads within the AZ. A classification has been carried out for the unpaved roads leading to relatively well passable roads (road type three) and more difficult passable roads (road type four). The distances to major towns and markets in the AZ and San José for each road type serve as explanatory variables in the study on transportation costs. Errors in distances of the various road types in the farm survey are small due to the use 1:50,000 maps on which farms are indicated. Errors in distances for the farmer market survey and the cattle survey may be larger since the exact position of the farm is not known.

The farmer market survey generated data on transportation costs for farmers that offer their produce at local farmer markets. Although these data might correspond with those from the farm survey, they were analyzed separately due to an expected larger error in the distance from farm to farmer market. Since the location of the farm is described rather vaguely, there are likely to

be errors in the data on distance to the market. From the cattle survey, costs of transporting cattle from different parts of the AZ to the cattle auction are used. Distance to the auction is subject to an error due to the fact that the exact geographical position of the farm from which the animals originate is not known. In this way four data sets were created:

* Data set 1, containing data on the transportation of inputs from the market place to the farm. This is in general data with a *taxi carga* (taxi with possibility to transport up to 500 kilo).
* Data set 2, containing data on the transport of agricultural produce from the farm-gate to market places other than the farmer market, mostly referring to packing industries and local groceries in the AZ and to market places in the Valle Central (CENADA, traditional markets, packing industries). The data refer to pick-up trucks with the possibility to transport between 1 and 2.5 tons.
* Data set 3, on the transport of agricultural produce from the farm-gate to farmer markets in the AZ.
* Data set 4, on the transport of cattle from the farm-gate to the cattle auction.

3.3 Multiple regression analysis

Each of the data-sets were used in the estimation of regression models. As has been concluded in former studies transportation costs are correlated with distance. Here, it is logically presumed that the total costs of hiring a vehicle depends on the carrying capacity of the vehicle and the distance to the farm, or the market place. Data on distances on four road types in the whole study area enable a specification of costs per road type.

$$TC = f \text{ (distance on road types, vehicle's carrying capacity)}$$

TC = Total transport costs per journey in colones (¢)

The dependent variable is transport costs as mentioned by the farmer while independent variables are the carrying capacity of the vehicle (in tons) and distances on the different road types. Linear and non-linear models are built. The models differ in the number and combination of variables included and in the functional form applied. In this way, for each of the models the fixed costs

and operating costs are influenced by different effects of distance on road types and carrying capacity of the vehicle. Three linear functions and three non-linear functions are developed, each with another assumption of the influence of the different explanatory variables. First the functional forms applied for each of the models is explained, and second, the combination of variables included in each of the models is presented.

(A) Linear model based on distance per road type

$$TC = \alpha_0 + \sum_{i=1}^{4} (\alpha_i * road_i)$$

TC = Total costs of hiring transport in ¢

$road_i$ = Distance in kilometre on road type i

α_0 = intercept, indicative of fixed costs

α_i = coefficient on the influence of the distance on $road_i$ on costs, costs per kilometre

Model A presents a simple regression between costs and the distances per road type. No relation between carrying capacity of the vehicle and costs per unit distance is assumed. This model might serve for those data sets in which the number of tons of the vehicle does not influence costs.

(B) Linear model based on distance per road type and carrying capacity (in tons)

$$TC=(\alpha_0+\beta_0*tons)+\sum_{i=1}^{4}(\alpha_i*road_i)$$

TC	= Total costs of hiring transport in ¢
$road_i$	= Distance in kilometre on $road_i$
α_i	= Regression coefficient on $road_i$, or costs per kilometre
α_0	= Intercept
$ß_0$	= Regression coefficient on the number of tons

Model B presumes a linear regression on the distances per road type and the number of tons of the vehicle. The carrying capacity of the vehicle is included as an independent variable, influencing only the fixed costs. No relation is assumed between carrying capacity and distance. This model might serve for those data sets in which costs partly are determined by the carrying capacity of the vehicle.

(D) The logarithmic model

$$TC=(\alpha_0+\beta_0*tons)+(\delta+\beta_1*tons)*\ln\sum_{i=1}^{4}(\alpha_i*road_i+1)$$

TC	= Total transport costs per transport arrangement in ¢
ln	= Natural logarithm
$road_i$	= Distance in kilometre on $road_i$
α_i	= Regression coefficient on $road_i$,
α_0	= Intercept
$ß_0$	= Regression coefficient on the number of tons
$ß_1$	= Regression coefficient on interaction between carrying capacity of vehicle and road type
δ	= Regression coefficient on the logarithmic function of the road

The values for α_i represent weight factors in contrast to the linear models where α_i represented the estimated costs per kilometre road type. In the estimation process, the α_i's are forced to be larger than zero, since it is not possible to take the natural logarithm of a negative value. The ln-function fits under the assumption that the costs per kilometre decrease as distance increases.

(E) The logarithmic/power model

$$TC=(\alpha_0+\beta_0*tons)+(\delta+\beta_1*tons)*\{\ln\sum_{i=1}^{4}(\alpha_i*road_i+1)\}^{\epsilon}$$

TC	= Total transport costs in ¢
$Road_i$	= Distance in kilometre on $road_i$
α_i	= Regression coefficient on $road_i$
α_0	= Intercept, or fixed costs
$ß_0$	= Regression coefficient of the number of tons
$ß_1$	= Regression coefficient of number of tons in relation with the logarithmic/power function of the road types
δ	= Regression coefficient of the logarithmic/power function of the road types
ϵ	= Power function

The power function is introduced to smoothen the strong effect of the logarithmic function.

(F) The power model

$$TC=(\alpha_0+\beta_0*tons)+(\delta+\beta_1*tons)*\{\sum_{i=1}^{4}(\alpha_i*road_i)\}^{\epsilon}$$

TC	= Total transport costs in ¢
$Road_i$	= Distance in kilometre on road type one to four
α_i	= Regression coefficient on road one to four
α_0	= Intercept, or fixed costs
$ß_0$	= Regression coefficient of the number of tons
$ß_1$	= Regression coefficient of number of tons in relation with the power function of the road types
δ	= Regression coefficient of the power function of the road types.
ϵ	= Power function

As an alternative to the logarithmic model, that has a strong conversion effect on distances of different order of magnitude, the power model was developed.

Each of these linear and non-linear models was estimated using data set 1, data set 2 and data set 4. Data set 3 on the transportation of produce to the local markets were not used since the number of observation is to small (13) to lead to significant results.

Regression estimates based on the four road types resulted non-significant values for *road1*. Estimation of input transportation is therefore based on three road types. *Road2*, *road3* and *road4* are included in the regression analysis either single or combined with each other (table 3.1). Where inputs are transported on *road1*, distances are very small, since input shops are scattered along the main road San José - Limón.

Table 3.1: Model variants of input transportation

variant	ROAD2	ROAD3	ROAD4	ROAD23*	ROAD34	ROAD234
1	x	x	x	-	-	-
2	-	-	x	x	-	-
3	x	-	-	-	x	-
4	-	-	-	-	-	x

* $ROAD_{i,j}$ = combined distance of road type i with j.

Estimation of transportation of output and cattle is performed using the same models as for inputs. However, since also road type is included as an independent variable, more variants are estimated (table 3.2).

Table 3.2 Variants of road types included in output and cattle transportation

variant	ROAD1	ROAD2	ROAD3	ROAD4	ROAD12*	ROAD34*	ROAD23*	ROAD123	ROAD234	ROAD1234
1	x	x	x	x	-	-	-	-	-	-
2	-	-	x	x	x	-	-	-	-	-
3	x	x	-	-	-	x	-	-	-	-
4	x	-	-	x	-	-	x	-	-	-
5	-	-	-	-	x	x	-	-	-	-
6	-	-	-	x	-	-	-	x	-	-
7	x	-	-	-	-	-	-	-	x	-
8	-	-	-	-	-	-	-	-	-	x

* $ROAD_{i,j}$ = combined distance of road type i with j.

The objective of the study on relation between transport costs and distance aims to differentiate among the four road types. The aim is to find a model that estimates the costs according to expectations and with significant coefficients for the estimated variables.

In contrast to linear regression estimations that are executed with SAS, non-linear functions are estimated with the 'SOLVER' function of Excel, which did not present convergence problems. Besides, results obtained with Excel seem to be less dependent on the initial values of the parameters. In all instances, models where optimized by minimizing the sum of squared errors. For indication of goodness of fit of the non-linear models, the R^2 of the linear regression of the estimated costs with the observed costs is presented.

3.4 Results and discussion on farm survey data

3.4.1 Summary statistics on farm survey data

A total of 86 farmers was interviewed during the field survey. Division of number of farms per canton and district is presented in appendix 4. Fifty-nine farmers responded to the transport questions, resulting in 105 observations since some farmers lack information, while others reported more than one transport arrangement. One of the observations was deleted, since the reported costs was unlikely high compared to other costs over the same distance. A large part of the crops and inputs is transported by small trucks or pick-up's. Regression analysis on data sets 1 and 2 shows that especially heavy trucks have a strong influence on outcome of the regression fit. However, since only a very small part of the farmers makes use of heavy trucks, observations in which the vehicle's carrying capacity exceeds 2.5 tons (7 observations) were excluded from the analysis. Data set 1 contains 43 observations while data-set 2 contains 56 observations.

Summary statistics of data-set 1 and data-set 2 (Table 3.3 and 3.4), include the number of observations, the mean, the coefficient of variation and minimum and maximum value observed.

Table 3.3 Summary statistics of farm input transportation data (data set 1)

Variable	N	Mean	C.V.	Minimum	Maximum
road2	43	3.739	1.24	0	19.1
road3	43	3.541	1.029	0	16.8
road4	43	3.820	0.996	0	14.3
road23	43	7.281	0.761	0	19.1
road34	43	7.363	0.603	0	16.8
road234	43	11.102	0.534	3.3	31.6
TONS	43	1.209	0.289	0.5	1.5
COST	43	1416	0.646	350.0	6000

C.V. = Coefficient of variation

The spread in value of some variables in data-set 1 is considerable as evidenced by coefficients of variation that exceed, or are close to, one. The spread in the combined data is small relative to the spread in the data for each individual road type. The coefficient of variation of the carrying capacity variable is low, since inputs generally are transported in pick-up's or taxis, with a low carrying capacity.

Table 3.4 Summary statistics of farm output transportation data (data set 2)

Variable	N	Mean	C.V.	Minimum	Maximum
road1	56	16.772	1.620	0	79.0
road2	56	6.521	1.107	0	27.2
road3	56	4.105	1.017	0	16.8
road4	56	4.539	1.010	0	18.1
road12	56	23.283	1.252	0	98.0
road34	56	8.645	0.550	0	22.0
road23	56	10.627	0.748	0	30.2
road123	56	27.389	1.070	0	99.4
road234	56	15.166	0.637	3.0	40.9
road1234	56	31.929	0.877	3.0	110.5
TONS	56	1.607	0.406	0.5	2.5
COST	56	3999	0.406	350.0	15000.0

C.V. = Coefficient of variation

The spread in the data for data set 2 is also considerable. Distance on road type 1 is larger than in data set 1. Agricultural produce is transported over larger distances since the former is sold at markets that are further away from farms than are input shops. An increased spread in the carrying capacity variable can also be noticed, since vehicles with a relatively high carrying capacity are used more frequently for longer distances.

3.4.2 Linear regression estimation results for inputs and output

A-priori, under conditions of rational pricing one may expect that the coefficients α_i are positive and increase with declining road quality. Also α_0 should be positive, since it is assumed that a certain amount of fixed costs is charged for the transport arrangement. Furthermore, $ß_0$ in model B should be positive since costs increase as the number of tons of the vehicle increases.

Table 3.5: Regression results for input transportation data, model A, four variants

model	A1	A2	A3	A4
N	43	43	43	43
intercept	185	125	180	128
road2	127***	-	128***	-
road3	92***	-	-	-
road4	113***	118***	-	-
road23	-	115***	-	-
road34	-	-	103***	-
road234	-	-	-	116***
R2	0.58	0.56	0.57	0.56
F	18***	26***	27***	54***

*** = significant at 1% level

** = significance at 5% level

* = significance at 10% level

In model A for input transportation the intercept for all four model variants is not significant (Table 3.5). The coefficients of model A1 and A3 are not according to expectations, since the coefficients for low quality roads are lower than for high quality roads. Model A2 indicates a higher, although very slightly, coefficient for *road4* than for *road23*. The simplest model A4 seems to give an equally good fit of transport costs, as in model A2. Coefficients for model A2 should be tested if they differ significantly, if so, model A2 is to be preferred above A4. Differentiation per road type could not be proved significantly in data set 1.

Table 3.6: Regression estimates for input transportation, model B, 4 variants

model	B1	B2	B3	B4
N	43	43	43	43
intercept	281	207	287	211
road2	131***	-	132***	-
road3	95***	-	-	-
road4	115	121***	-	-
road23	-	118***	-	-
road34	-	-	106***	-
road234	-	-	-	119***
TONS	-111	-95	-123	-97
R2	0.58	0.57	0.58	0.57
F	13***	17***	18***	26***

*** = significant at 1% level
** = significance at 5% level
* = significance at 10% level

Introduction of the number of tons in the fixed costs in model B does not significantly improve the explanation of transportation costs of inputs (Table 3.6). The R^2 remains around 57%. The coefficients for the intercept and for *tons* are not significant which may be caused by the small variability in the data. Again, costs on low quality roads seem to be higher than costs on good quality roads. Significance of the difference between the coefficients between *road23* and *road4* should be tested.

Table 3.7: Regression results for output transportation, model A, 7 variants

model	A1	A2	A3	A4	A5	A6	A7	A8
N	56	56	56	56	56	56	56	56
intercept	243	245	252	846*	258	1088**	845**	1318***
road1	84***	-	85***	79***	-	-	79***	-
road2	78**	-	71**	-	-	-	-	-
road3	233***	233***	-	-	-	-	-	-
road4	193***	189***	-	119**	-	134**	-	-
road12	-	83***	-	-	84***	-	-	-
road34	-	-	215***	-	207***	-	-	-
road23	-	-	-	121***	-	-	-	-
road123	-	-	-	-	-	84***	-	-
road234	-	-	-	-	-	-	120***	-
road1234	--	-	-	-	-	-	-	84***
R2	0.67	0.68	0.67	0.65	0.67	0.64	0.65	0.64
F	27***	36***	36***	32***	55***	48***	50***	95***

*** = 99% significance

** = 95% significance

* = 90 % significance

Model A on output transportation data shows significant values for the intercept for models A4, A5, A7 and A8 (Table 3.7). The coefficients for model A1 are not according to expectations, although the coefficients over *road3* and *road4* are higher than over *road1* and *road4*. Model A4 presents coefficients that are not according expectations, although the costs on *road23* differ only slightly from the cost on *road4*. This seems to indicate that costs hardly can be differentiated among *road2*, *road3* and *road4*. Model A6 and A7 both give significant outcomes, with coefficients according expectations. Model A5 is chosen as the preferred model because coefficients are according expectations, R^2 is high, and only a limited number of variables is used. Inclusion of more variables into model A does not significantly improve the model results. To conclude, cost of output transportation depends on distance on roads and on the quality of roads. However, costs per road type can only be differentiated on two road types, namely *road12* and *road34*.

Table 3.8: Output transportation data, model B, 7 variants

model	B1	B2	B3	B4	B5	B6	B7	B8
N	56	56	56	56	56	56	56	56
intercept	-1089	-1050	-1049	-762	-1036	-747	-588	-305
road1	77***	-	76***	72***	-	-	71***	-
road2	55	-	59*	-	-	-	-	-
road3	176***	174***	-	-	-	-	-	-
road4	197***	181***	-	141***	-	146***	-	-
road12	-	74***	-	-	74***	-	-	-
road34	-	-	187***	-	179***	-	-	-
road23	-	-	-	85***	-	-	-	-
road123	-	-	-	-	-	73***	-	-
road234	-	-	-	-	-	-	102***	-
road1234	-	-	-	-	-	-	-	74***
TONS	1137***	1107***	1099***	1245***	1094***	1288***	1153***	1212***
R2	0.72	0.72	0.72	0.65	0.72	0.70	0.72	0.69
F	26***	33***	33***	32***	45***	42***	33***	60***

*** = 99% significance
** = 95% significance
* = 90 % significance

Introduction of carrying capacity (in tons) in model B of out put transportation leads to non-significant negative intercepts (Table 3.8). Fixed costs have a positive value only for those transport arrangements in which the carrying capacity is at least one ton. *Road2* is the only variable that does not give significant values according to expectations. Thus, inclusion in the model of a variable for *road2* is not recommended. Model B2 and B4 differentiate among three road types, and present highly significant coefficients that are according to expectations. However, model B5 is preferable because it has less variables and a higher R^2.

To conclude, introduction of the number of tons considerably improves the estimation of transportation costs for output. Transportation costs depend on carrying capacity and on the distance and quality of roads. Road types can be differentiated according to *road12* and *road34*. Transport of outputs is done by vehicles with a larger spread in carrying capacity than

transportation of inputs, therefore the number of tons contributes better to the estimation of the transportation costs of output than for inputs. Model A4 seems to fit best for the input transportation data, while model B5 fits best for output transportation.

3.4.3 Non-linear regression and power estimation results for inputs and output

Results of estimation of transportation costs for inputs by non linear models are not presented, since the linear regression results indicated that the vehicle's carrying capacity does not contribute significantly to the estimation of the transport costs.

For the output transportation estimates, expectations for the coefficients of the road types are similar for models D, E and F. Results are presented for the variant 1 because it differentiates among all road types, and variant 5 and 8, since the linear results already indicated that these variants generally result in the best fit.

Table 3.9: Non-linear regression results for output transportation data, model D, E and F.

model	D1	D5	D8	E1	E5	E8	F1	F5	F8
intercept	15.5	9.86	-389	166	45.9	14.8	43.6	-	134
road1	0.0074	-	-	1.28	-	-	1**	-	-
road2	0.0112	-	-	2.09	-	-	1.34	-	-
road3	0.0057	-	-	min*	-	-	min*	-	-
road4	0.0157	-	-	2.22	-	-	2.67	-	-
road12	-	0.0563	-	-	0.723	-	-	1**	-
road34	-	0.0732	-	-	0.799	-	-	min*	-
road1234	-	-	0.256	-	-	0.670	-	-	1**
ß0	223	64.2	-476	338	1045	1074	1317	1319	1220
ß1	3631	1765	855	0.735	-1.07	-1.64	-0.113	-0.0159	-4.35
δ	6393	423	917	6.69	5.48	8.267	0.550	0.0618	19.4
ε	-	-	-	4.35	5.24	5.04	2.15	2.69	1.40
$\Sigma error^2$	1.62E+8	2.08E+8	2.2E+8	1.56E+8	1.62E+8	1.62E+8	88184315	1.36E+8	1.31E+8
R^2	0.74	0.65	0.64	0.75	0.74	0.74	0.82	0.73	0.74

* = Minimum value was reached, i.e. value is effectively zero

** = Value was fixed at 1.

Coefficients of *road3* in all models are low and even reach minimum values in model E and F, an indication that this model specification is not suitable to the data (Table 3.9). The logarithmic model, D, leads to the lowest regression fit of observed minus estimated costs. The coefficients for the road types in model D are very small resulting from the high value of δ. The operating costs in model D are predominantly determined by a high value of $ß_1$ and δ. The combined logarithmic-power model E shows higher coefficients for the road types, and lower coefficients for $ß_1$ and δ. The fixed costs in model E are larger than in model D, indicating that in model D a larger part of the transportation costs is explained by distance. The power coefficient in model E is high to compensate for the effect of the ln-function, in contrast to model F, where the power coefficient is much lower though still well above unity, indicating that the costs per kilometre increase as distance increase. Model F5 leads to a minimum value for *road3*, which is contrary to expectations. To conclude, model E5 leads to coefficients according to expectations and serves

as the non-linear model that fits best.

The estimation of input transportation is best explained by linear models since the vehicle's carrying capacity does not contribute significantly to the estimation. Output transportation, however, can also be estimated by applying non-linear models, the combined logarithmic-power model E5 seems to fit best. Nevertheless, the linear models B5 or B8 are more user friendly than non-linear models and result in reasonable high R^2.

3.5 Results on farmer markets

A total of 22 farmers is interviewed at the farmer markets of Limón, Batán, Siquirres, Guápiles and Cariari, between December 1994 and January 1995. A total of 24 records on transportation costs is recorded since some farmers reported more than one transport arrangement. However, only 13 observations contained all necessary information for regression analysis. Coefficients are only seldom significant and are therefore not discussed in this paragraph.

3.6 Results on cattle auction

3.6.1 Summary statistics on cattle transportation

Data on transport of cattle were gathered on two auction days (26-09-95 and 28-09-95). On the first day, 120 sellers and 69 buyers were active at the auction, while in total 719 animals were auctioned. On the second day these numbers are respectively 102, 70 and 563.

Ninety-seven transporters originating from the northern AZ were asked on the costs they charge for the transport of animals (appendix 3). Roughly about 80 % of the animals auctioned in Guápiles originate from the northern AZ. During data checking, six observations had to be excluded from the analysis since the location of the farm was not indicated correctly.

Informal conversations confirm that cost of transport depend partly on the distance and quality of roads. Transporters point out that also the time invested in delivering the animals at the auction contribute considerably to the costs they charge. Transporters generally arrive between 6.00 and 10.00 a.m. and have to wait in line until the animals can be unloaded. On busy days,

it can take up to four hours before the animals are unloaded. For this reason, fixed costs partly representing the time invested unloading, are expected to be more important than in models for farm inputs and crop produce.

Ninety-five percent of the transporters own the vehicle that they drive. The transporters in this study all transport animals for other farmers or traders. However, 36 % of the transporters partly transported also their own animals.

The most common method of paying for transport of animals is per journey (78% of the observations), independent of the number of animals, until a certain weight depending on the carrying capacity of the vehicle, is reached. Nevertheless, in a number of cases a fixed amount is calculated per animal, independent of the weight of the animal. The latter method is usually applied in cases in which the transporter transports also his own animals as well. To fill-up excess capacity, other farmers can rent space in the vehicle for their animals.

In the estimation of costs for transporting cattle, the observations available for transport cost are specified per journey are in first instance analysed. The regression results for the estimated costs per journey (78%) are compared with the results in which the costs per animal (22%) are converted to costs per journey. The average load of animals is generally less than full capacity (Table 3.10), therefore the conversion rate should represent a logical relation between number of tons of the vehicle and the number of animals that is estimated to be transported. The observations in which the costs are calculated per journey are taken as a base for the conversion rate. The observations in which the costs are specified per animal are multiplied with the average number of animals transported per ton carrying capacity of the observations of costs per journey.

Table 3.10: Carrying capacity of vehicle, maximum carrying capacity, average number of animals and conversion rate

Carrying capacity (tons)	Maximum carrying capacity (animals*)	Number of observations	Average number of animals**	Conversion rate or estimated nr. of animals
1.5	4	3	3	3
2.0	5	8	4	4
2.5	6	28	5	5
3.0	7	11	7	6
3.5	8	6	6	7
4.0	9	2	8	8
4.5	10	3	7	8
5.0	12	1	10	10
5.5	14	0	-	11
6.0	15	1	11	11
6.5	16	2	12	12
7.0	17	4	9	12

* = equivalent of fully grown cows

**= animal size differs from young cows, to full grown bulls.

The summary statistics for data set 4a on the costs per journey and for data set 4b on the costs per journey and per animal include the number of observations, the mean, the coefficient of variation and the minimum and maximum value.

Table 3.11: Summary statistics on the transportation of cattle (data set 4a. cost per journey)

Variable	N	Mean	C.V.	Minimum	Maximum
road1	70	10.5	1.7	0	85.4
road2	70	11.3	0.9	0	27.7
road3	70	2.5	1.6	0	16.8
road4	70	2.8	1.6	0	13.5
road12	70	21.8	0.7	0	85.4
road34	70	5.3	1.2	0	17.4
road23	70	13.8	0.8	0	34.4
road123	70	24.3	0.7	2.6	85.4
road234	70	16.6	0.8	0	40.5
road1234	70	27.1	0.7	3.9	85.4
TONS	70	3.2	0.4	1.5	7.0
COST	70	5757.0	0.6	2,000	17,000

Table 3.12: Summary statistics on the transportation of cattle (data set 4b, cost per journey and per animal)

Variable	N	Mean	C.V.	minimum	Maximum
road1	91	11.4	1.5	0	85.4
road2	91	11.3	0.8	0	27.7
road3	91	2.4	1.7	0	16.8
road4	91	2.7	1.5	0	13.5
road12	91	23.1	0.7	0	85.4
road34	91	5.1	1.2	0	17.4
road23	91	14.2	0.7	0	35.0
road123	91	25.5	0.7	0	85.4
road234	91	16.8	0.8	0	40.5
road1234	91	28.1	0.6	3.2	85.4
TONS	91	3.1	0.5	1.5	7.0
COST	91	5,676.0	0.5	2,000.0	17,000.0

C.V. The coefficient of variation

The coefficient of variation for data set 4a (N=70) is slightly higher than for data set 4b (N=91) Table 3.12). However the differences are not that large that data set 4b should be excluded from regression estimation. For both sets, cattle transportation on *road2* shows a relatively low spread in observations. Besides, the average distance on *road3* and *road4* is very small. This indicates that cattle is especially transported from farms that are situated closely to high quality roads. Transporters at the auction mentioned the closest village from the farm from which the animals are transported. From the farm to the village, distances are most likely on low quality roads which are not taken into account.

3.6.1 Linear regression results for cattle transportation

Variation in cattle transportation costs is explained applying the same models as for input and output transportation.

Table 3.13: Regression results of cattle transportation (data set 4a, transport per journey), model A, 8 variants

model	A1	A2	A3	A4	A5	A6	A7	A8
N	70	70	70	70	70	70	70	70
intercept	2500***	2137***	2361***	2069***	1972***	2086***	2161***	1997***
road1	127***	-	135***	143***	-	-	143***	-
road2	105***	-	88***	-	-	-	-	-
road3	295***	299	-	-	-	-	-	-
road4	70	47	-	64	-	67	-	-
road12	-	125***	-	-	134***	-	-	-
road34	-	-	184***	-	162***	-	-	-
road23	-	-	-	145***	-	-	-	-
road123	-	-	-	-	-	143***	-	-
road234	-	-	-	-	-	-	126***	-
road1234	-	-	-	-	-	-	-	138***
R2	0.67	0.67	0.63	0.62	0.61	0.63	0.62	0.61
F	33***	44***	39***	37***	54***	57***	55***	110***

*** = 99% significance

** = 95% significance

* = 90 % significance

Table 3.14: Regression results of cattle transportation (data set 4b, transport per journey and per animal), model A, 8 variants

model	A1	A2	A3	A4	A5	A6	A7	A8
N	91	91	91	91	91	91	91	91
intercept	2460***	2327***	2478***	2284***	2196***	2270***	2342***	2207***
road1	115***	-	122***	127***	-	-	127***	-
road2	98***	-	87***	-	-	-	-	-
road3	237***	241***	-	-	-	-	-	-
road4	66	48	-	64	-	62	-	-
road12	-	114***	-	-	120***	-	-	-
road34	-	-	155***	-	140***	-	-	-
road23	-	-	-	125***	-	-	-	-
road123	-	-	-	-	-	127***	-	-
road234	-	-	-	-	-	-	112***	-
road1234	-	-	-	-	-	-	-	123***
R^2	0.54	0.54	0.52	0.52	0.51	0.51	0.51	0.51
F	26***	34***	32***	31***	46***	47***	47***	93***

*** = 99% significance

** = 95% significance

* = 90 % significance

C.V. = coefficient of variation

Linear regression results of cattle transportation lead to coefficients for data set 4a that are only slightly different from the results of data set 4b (Table 3.13 and 3.14). The conversion of the costs per animal therefore seem to give a reasonable estimate of the transport per journey, for those observations for which the costs are specified per animal. The main difference between the two data sets is that the estimation of the costs per journey (data set 4a), leads to a considerably higher explanation of total variance of the transport costs.

The intercept for all variants of model A is significant and high compared to input and output results. *Road4* in model A1 presents very low and non-significant values. *Road2* shows a drop in value compared to the coefficient of *road1*, but in contrary to *road4,* is highly significant. Model A5, and A8 present for both data sets coefficients that are according to expectations.

Model A5 is preferred above model A8 if a significance test proves that *road12* is significantly different from *road34*.

Table 3.15 Regression results for cattle (data set 4a, costs per journey), model B, 8 variants

model	B1	B2	B3	B4	B5	B6	B7	B8
N	70	70	70	70	70	70	70	70
intercept	403	411	267	20	80	205	60	38
road1	107***	-	110***	114***	-	-	114***	-
road2	107***	-	96***	-	-	-	-	-
road3	234***	235***	-	-	-	-	-	-
road4	76	77	-	75	-	95	-	-
road12	-	107***	-	-	109***	-	-	-
road34	-	-	155***	-	148***	-	-	-
road23	-	-	-	133***	-	-	-	-
road123	-	-	-	-	-	118***	-	-
road234	-	-	-	-	-	-	119***	-
road1234	-	-	-	-	-	-	-	116***
TONS	695***	694***	760***	782***	789***	762***	792***	779***
R2	0.74	0.74	0.73	0.73	0.73	0.72	0.72	0.72
F	37***	48***	44***	43***	59***	58***	57***	88***

*** = 99% significance

** = 95% significance

* = 90 % significance

Table 3.16: Regression results for cattle, (data set 4b, transport per journey and per animal) model B, 8 variants

model	B1	B2	B3	B4	B5	B6	B7	B8
N	91	91	91	91	91	91	91	91
intercept	140	204	94	-62	27	96	3	38
road1	95***	-	99***	101***	-	-	101***	-
road2	101***	-	93***	-	-	-	-	-
road3	187***	186***	-	-	-	-	-	-
road4	55	61	-	53	-	70	-	-
road12	-	96***	-	-	99***	-	-	-
road34	-	-	123***	-	120***	-	-	-
road23	-	-	-	118***	-	-	-	-
road123	-	-	-	-	-	104***	-	-
road234	-	-	-	-	-	-	104***	-
road1234	-	-	-	-	-	-	-	102***
TONS	856***	848***	877***	891***	885***	875***	890***	886***
R2	0.69	0.69	0.68	0.68	0.68	0.68	0.67	0.67
F	38***	48***	45***	46***	61***	61***	61***	92***

*** = 99% significance
** = 95% significance
* = 90 % significance

Linear regression results for cattle transportation, applying model B, results in 10 % higher R^2 for data set 4a. The coefficient for *tons* is lower for data set 4a, indicating that fixed costs in the estimation of transportation costs per journey seems to depend less on the carrying capacity then for estimation of transportation costs per animal (Table 3.15 and 3.16).

Fixed costs are positive for all types of vehicles, since the intercept and the coefficient for *tons* are positive. Similar to model A, a low and non-significant coefficient for road4 is found. Model B1 shows for *road1*, *road2* and *road3* coefficients according to expectations, but in model B3 a drop in value for *road2* can be noticed. The vehicle's carrying capacity contributes considerably to the estimation of cattle transportation since the R^2 is higher for model B than for model A. Therefore, if a significance test proves that coefficients for *road12* and *road34* significantly differ

from each other, model B5 seems to give the best fit for transportation of cattle. Otherwise, model B8 can be chosen. Cattle transportation depends on the distance on two road types as well as carrying capacity (in tons). As expected, the fixed costs for cattle transportation are higher than for output transportation because the transport of cattle includes a large unloading time at the auction.

3.6.2 Non-linear regression results for cattle transportation

The non-linear models, D, E and F are used in the estimation of cattle transportation. Linear regression results proved that the estimation of cattle transportation lead to higher regression fits for data set 4a, in which the costs are calculated per journey. Data set 4a is therefore used in the non-linear regression analysis. Furthermore, the results of the variants 5, and 8 resulted in coefficients according expectations. Variant 1 is also presented because costs are differentiated per road type.

Table 3.17: Non-linear regression results for cattle transportation (data set 4a, costs per journey)

model	D1	D5	D8	E1	E5	E8	F1	F5	F8
N	70	70	70	70	70	70	70	70	70
intercept	1.89	-1270	307	98.5	19.8	-307	262	-791	-994
road1	0.009	-	-	0.248	-	-	1**	-	-
road2	0.010	-	-	0.232	-	-	1.11	-	-
road3	0.020	-	-	0.484	-	-	1.75	-	-
road4	min*	-	-	0.153	-	-	1.15	-	-
road12	-	min*	-	-	0.12	-	-	1**	-
road34	-	min*	-	-	0.13	-	-	1.15	-
road1234	-	-	0.0086	-	-	0.0454	-	-	1**
B0	711	1164	657	1015	1056	1113	-54800	1153	1191
B1	190	-548073	503	-20.7	-70.5	-409	53766	-5.78	-7.53
δ	14959	7890865	15005	272	958	5273	2382	74.2	92.6
ϵ	-	-	-	3.41	2.94	2.09	0.011	1.18	1.14
Σ error^2	1.84E+8	1.81E+8	1.93E+8	1.65E+8	1.79E+8	1.79E+8	2.47E+8	1.8E+8	1.81E+8
R^2	0.73	0.74	0.72	0.76	0.74	0.74	0.64	0.74	0.74

* = minimum value is reached, and coefficient is effectively zero

** = value was set at 1

Estimation of operating costs for cattle transportation for model D are slightly determined by the coefficients of the road types, instead a high coefficient for δ is needed to equalize the ln-function (table 3.17). Besides for model D5, the coefficients reach minimum values and this model is therefore not preferred. Model E1 and F1 present coefficients for the road types according to expectations except for *road4*. Cattle transportation seems to be estimated best by the non-linear models E5 and F5 because coefficients seem to be according expectations.

The estimation of cattle transportation can be estimated by applying non-linear models, the combined logarithmic-power model E5 or the power model F5 seems to fit best. Nevertheless, the linear models B5 or B8 are more user friendly than non-linear models and result in reasonable high R^2.

4. FARM-GATE AND FARMER MARKET PRICES FOR AGRICULTURAL CROPS

4.1 Background

Prices at the farm-gate form the base of this chapter, with the ultimate purpose of defining economic zones. Economic zones are sub-regions based on distance to market places. Farm-gate prices for agricultural crops are assumed to be similar within each economic zone.

Farm-gate prices, collected through a farm-survey, are combined with the results from regression models estimated in chapter three, to analyze price differences resulting from geographical differences in farm location. Wholesale prices are used as a base for farm-gate price estimation in the AZ. However, wholesale prices can only be used for markets that are integrated. In other words, prices at the farm-gate level are at least partially determined by prices at the central wholesale market.

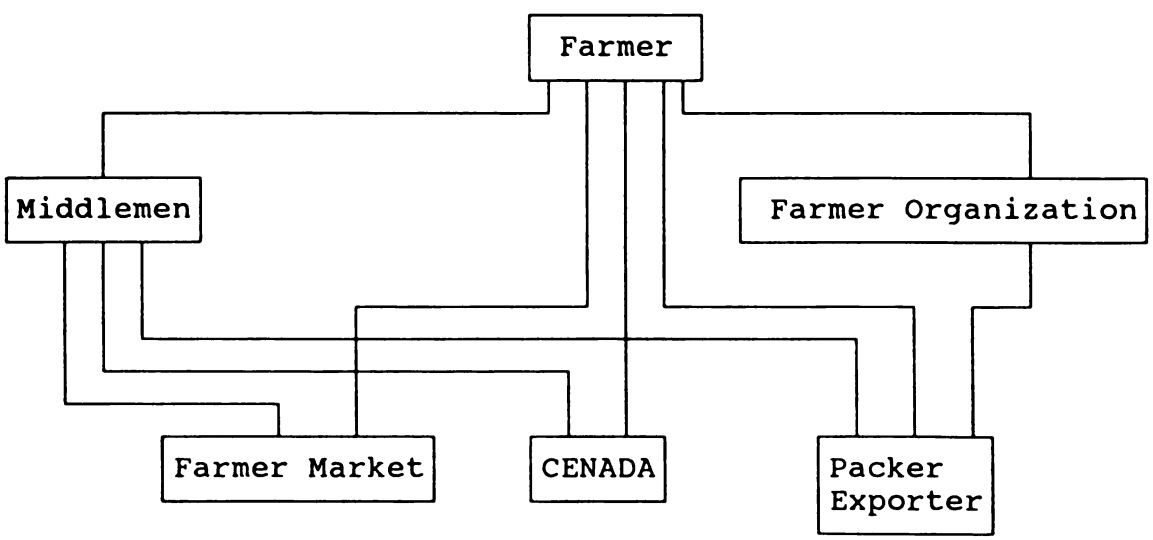
Market integration is tested through analysis of differences in prices at the farm-gate and at local or national markets. Differences in prices among markets are generally explained by marketing costs, which may include transportation costs, processing costs, government taxes, profit margins including compensation for risk of intermediaries and transaction costs. In a competitive market, transportation costs and 'normal' profit will fully account for the price differences (Ahmned & Rustagi, 1987). Calculation of farm-gate prices as a function of market prices is allowed under (near) perfect competition with fully integrated markets. However, when markets are not well integrated, price spreads among markets can be much larger and the use of national or local market prices in the estimation of farm-gate prices is not permitted. Van Tilburg (1993) tested market integration with Ravallion's models for nine markets in Senegal. Correlation coefficients of weekly millet prices proved that one market served as satellite market and prices at other markets were directly linked with the price at the satellite market.

Differences between farm-gate prices and CENADA prices, and between farm-gate prices and prices at local markets are studied to prove market integration.

It is difficult to estimate exactly which part of the price difference can be attributed to elements of the marketing margin other than transportation costs. Moreover, when price differences between farm-gate and local markets are calculated, each product should be considered separately since marketing margins are partially determined by product specific characteristics, e.g., papaya is highly perishable, marketing margins may be higher than for, e.g., cassava. Ouédraogo and Ndoye (1988) decomposed the gross margin of wholesalers who supply cereals from local markets in Senegal. Transportation costs account for 47% of the gross margin, and for 67% of the commercialisation costs. The gross margin includes a profit margin. However, for integrated markets, it can be assumed that transport costs account for a large part of the commercialisation costs and consequently for the differences between farm-gate and market prices.

Marketing outlets for products originating from the AZ include local farmer markets (*feria de agricultor)*, CENADA, local packers and processing industries and exporters (Table 4.1). For the relative importance of each marketing outlet reference is made to Hoekstra (1993), van Logtestijn (1993) and Tilburg *et al* (1996).

General marketing channel for crops



Middlemen still form the main marketing outlet for farmers in the Atlantic Zone, even though the number of farmer markets and the quantities supplied in these markets has increased over the last years (Van Tilburg *et al.*, 1996).

Some farmers transport export quality produce (Table 4.1) to the packing hall of the exporter; exporters are supplied by middlemen as well. In times of high demand, exporters may arrange their supply directly at farm level.

Table 4.1: Product names and markets for small and medium-scale farmers in the Atlantic Zone

Scientific name	English name	Local name	Local market	National market	Export market
Bactris gasipaes	heart of palm	palmito	X	X	X
Musa AAA	banana	banano	X	X	-
Musa AAB	plantain	plátano	X	X	X
Ananas comosus	pineapple	piña	X	X	-
Carica papaya L.	papaya	papaya	X	X	-
Manihot sculenta	cassava	cassava	X	X	X
Colocasia esculenta var. antiquorum	eddoe	ñampi	X	X	X
Xanthosoma saggitifolium	cocoyam	tiquisque	X	X	X
Dioscorea alata	yam	ñame	X	X	X
Cucurbita moschata	pumpkin	ayote	X	X	X
Cocos nucifera	coconut or jellynut	coco or pipa	X	X	X
Zea mays	corn	maiz	X	X	-

Sources: van Tilburg *et al.*(1996)

Farmer organizations form a growing marketing outlet for farmers, especially for palm heart and plantain (van Tilburg *et al*, 1996). Farmer organizations offer farmers advantages in the form of collective transport and a stronger position towards the marketing outlet through their membership. These advantages result in higher prices and a secure market outlet. However, cooperative organizations in the AZ handle only a small part of total marketed produce.

4.2 Materials and methods

Prices at the farm-gate, at farmer markets and at wholesale markets were obtained from different sources. Farm-gate prices were collected through a farm survey. Pilot area selection, farm household selection and sample unit are as in section 2.2. Data on farm-gate prices per region for some products are administered by the marketing Department of MAG (Minister of Agriculture and Livestock)/CNP(National Production Board) in San José. These prices are not geographically differentiated within the AZ, in contrast to the data of the farm survey, carried out by REPOSA.

The Marketing Department of MAG/CNP manages a large data set of prices of agricultural crops that are marketed at the CENADA wholesale market in Heredia. These data were used in the analysis of marketing margins. Prices at the CENADA are considered to reflect national supply and demand since a considerable portion of the national supply for a large number of products in marketed through the CENADA.

At the level of the farmer markets, prices were collected through a survey held at the markets of Guápiles, Cariari, Siquirres, Batán and Limón. General and specific problems of each farmer market were discussed with its administrator.

Checking the level of market integration according to the regular methods, (Ravallion, 1986) and (Lutz & van Tilburg, 1993) is not possible since not enough reliable data are available on farm-gate prices in the AZ. Instead, it is assumed that market integration is high for those products that correspond with high supply percentages at the CENADA. PIMA (Programa Integral de Mercadeo Agropecuario) keeps records on the origin of the products that are sold.

4.3 Results and discussion

4.3.1 Results on farm-gate prices

Market integration is tested through the calculation of the share of the 4 counties of the farm survey in products supplied at the CENADA wholesale market (Table 4.2).

Table 4.2 Supply at CENADA in 1994 (in kilo)

Product	Total supply at CENADA	Supply originating from province Limon	Supply originating from 4 counties in field survey	Supply originating from 4 counties as % of CENADA supply
cassava	2,099,515	59,275	59,275	2.8
cocoyam	305,595	7,000	7,000	2.2
papaya	4,553,848	1,619,280	1,619,280	35.5
plantain (mature)	1,048,015	757,520	209,143	19.9
plantain (green)	4,284,085	3,892,575	640,008	14.7
young maize	1,741,154	936,939	936,256	53.8
jelly nut	756,976	597,839	596,321	78.8
soursop	78,290	59,190	59,190	75.6

Source: CNP/ Department for Analyses and Market Information

The shares of the 4 counties included in the farm survey in total CENADA supply exceed 50% for young coconut, soursop, and young maize (Table 4.2). For these products it can be confidently assumed that wholesale prices are directly influenced by supplies from the AZ, specifically from the 4 counties included in the farm survey. The survey counties are also important suppliers of papaya and plantain. Talamanca county accounts for 76% of supply of plantain (green). Only very small shares were found for cassava and cocoyam. Still, cassava and cocoyam are important products in the AZ, but are predominantly marketed by packing and exporting companies that operate in the AZ. Farm-gate prices of cassava and other roosts and tubers are primarily determined by prices at export level. An important product from the AZ that does not appear at the CENADA market is palm heart. The AZ produces more than 50 % of national supply (Cardenas, 1995). Fresh palm heart is bought in large quantities by processing industries and is marketed in small quantities through local farmer markets.

The farm survey (N=84) includes 67 farmers (80%) that produce crops on a commercial base. The other 20 % concentrate farm activity on animal husbandry and only cultivate crops for home consumption. Eighty-eight percent of the farmers that produce crops commercially, sell their produce to middlemen.

Farmers that cultivated crops mentioned in total 106 observations on the cultivation of crops. For cocoyam, dry maize, cucumber, sweet pepper, eddoe, mature and young pumpkin, watermelon, cacao, and eddoe, not more than two data observations could be obtained. These products are therefore not included in the price analysis. The number of observations of these crops is small in spite of the relatively high prices that can be obtained for these products. Conversations with farmers clarified that cultivation of these products involves relatively high labor costs, high input costs, specific management, or a combination of these facts. Farmers in the AZ generally have good alternative off-farm employment possibilities which reduce the incentive to invest in crop cultivation. Cultivation of crops is considered as a risky business. Besides, a large number of farmers originates from other regions of the country and therefore lack knowledge on the cultivation of crops that are typical for the AZ.

Table 4.3: Observations on cultivated crops, buyers and average farm gate price (1995)

		Buyer at farm-gate level						average
crop	N1	a	b	c	d	e	N2	farm-gate price ¢
cassava	17	14	3	-	-	-	15	24.6/kg
maize (young)	13	13	-	-	-	-	13	5.8/unity
papaya	8	8	-	-	-	-	7	17.6/kg
yam	4	-	3	-	-	1	3	51.0/kg
plantain	14	13	-	-	1	-	10	9.6/unity
coconut (young)	9	8	-	-	1	-	7	6.6/unity
palm heart	14	7	1	6	-	-	9	34.0/unity
pineapple	6	6	-	-	-	-	5	52.0/kg
soursop	5	4	-	-	1	-	4	156.0/kg
total	90	73	7	6	3	1	73	

N1 = number of responses on a specific crop
N2 = number of responses on which average farm-gate price is calculated
a = middleman
b = exporter of packer
c = farmer organization
d = neighbors or tourists
e = crop not yet harvested or sold

Source: own field data

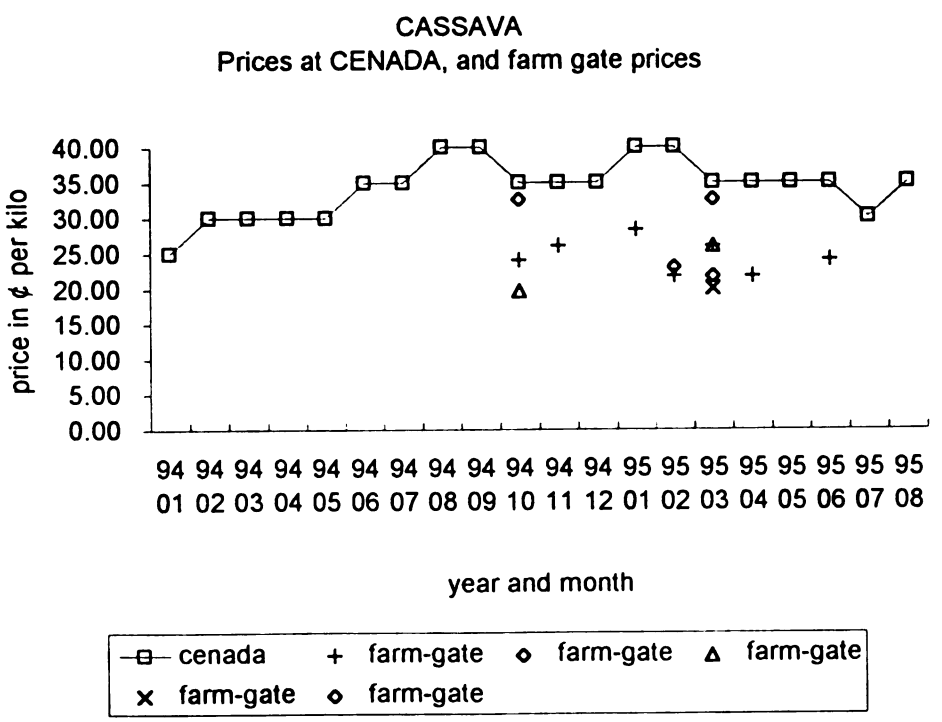
Eighty-one percent selling arrangements is marketed trough middlemen (Table 4.3). Palm heart is the only crop that is marketed partially through a farmer organization. Plantain is also marketed through a farmer organization, but these data were not obtained by the survey.

The farm-gate price is converted to standard units for those observations in which the farmer mentioned both selling date and price. Cassava is sold at the farm-gate per kilo or per bag. which on average contains 46 kg (pers com., PIMA). Plantain is sold at the farm gate per finger or per bunch (*racimo*). One bunch contains 25 fingers (pers com., PIMA). One farmer sold palm heart in small bags to a middleman. Each bag contains 1.5 palm heart. The farm-gate price per palm heart was ¢40, which is higher than for the unprocessed palm heart at ¢34 per palm heart. For plantain a considerable difference in farm-gate price can be found for farms that are situated in

the counties of Guápiles and Guacimo (¢7.3/unit) and those farms situated in the counties of Siquirres and Matina (¢10.6/unit). This difference can be explained by lower quality produce.

The relation between CENADA prices and farm-gate prices in time were analyzed. Farmers were asked at what date they sold their produce. While some farmers responded accurately, others only vaguely remembered the month in which they sold their produce. For that reason the modus of monthly CENADA prices were used. CENADA data are presented from January 1994 till August 1995, because in this way at least one year cycle is presented.

Figure 4.1: Farm-gate prices and CENADA prices for cassava (January 1994 -August 1995)

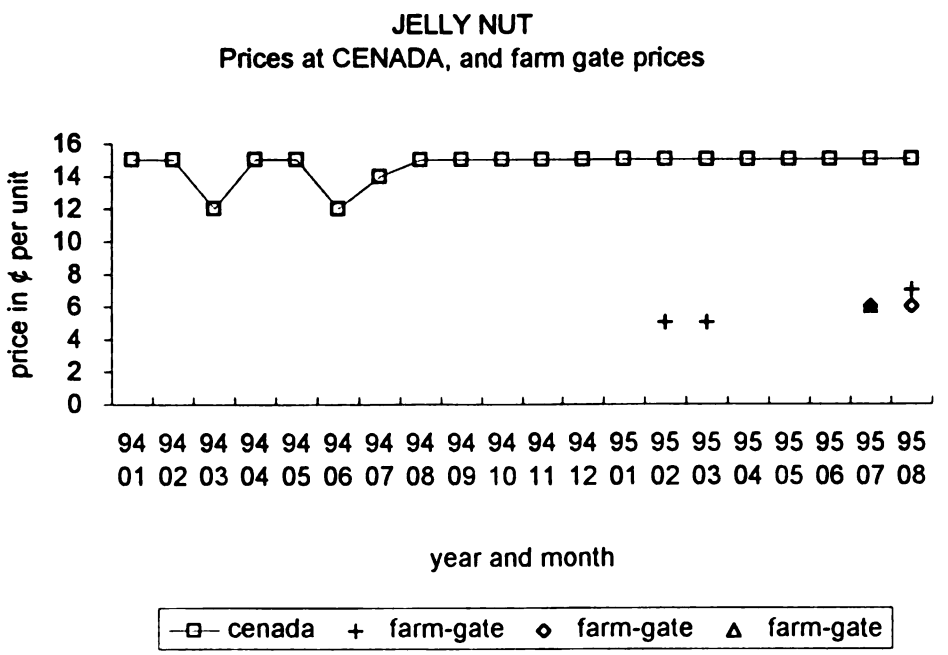


Source: farm survey, 1995 and Department of Price Information, CNP

Wholesale market prices for cassava fluctuate during the year, varying between ¢25 and ¢40 per kilo (Figure 4.1). Farm-gate prices are generally more than 50% of the CENADA price. Although supply of cassava at the CENADA originating from the AZ is very small, a relation between

farm-gate and CENADA price exists.

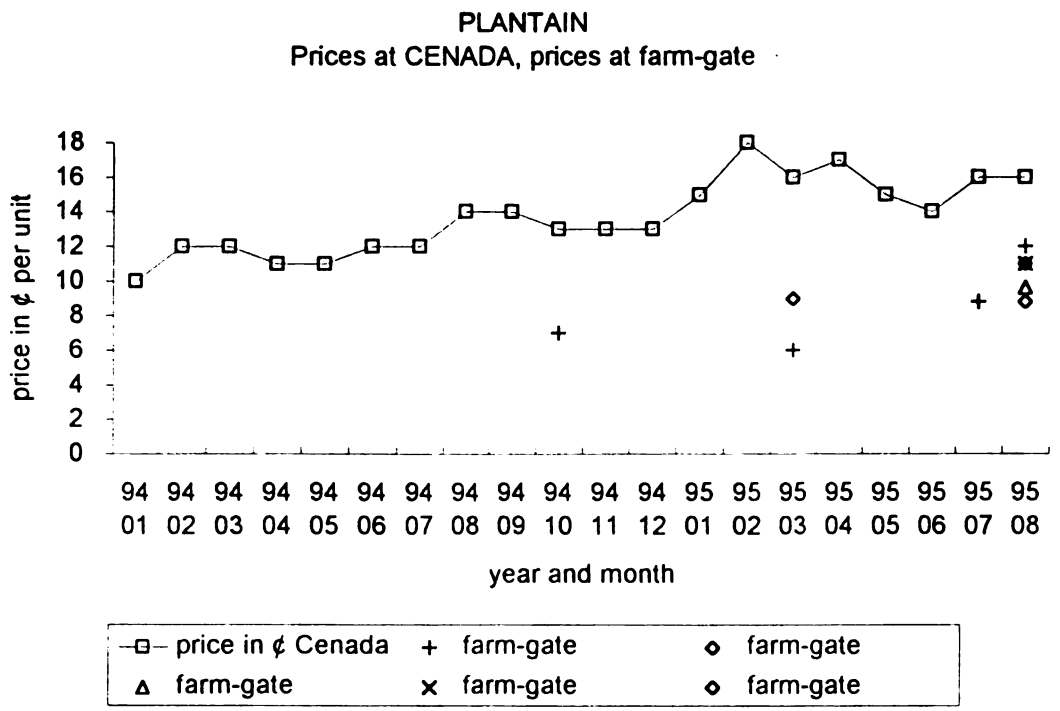
Figure 4.2: Farm-gate prices and CENADA prices for jelly nut (January 1994 -August 1995)



Source: farm survey, 1995 and Department of Price Information, CNP

Wholesale price for young coconut show a stable pattern since August 1994 of around ¢15 per unit. Farm-gate prices are also rather stable and account for roughly 30 % of CENADA price.

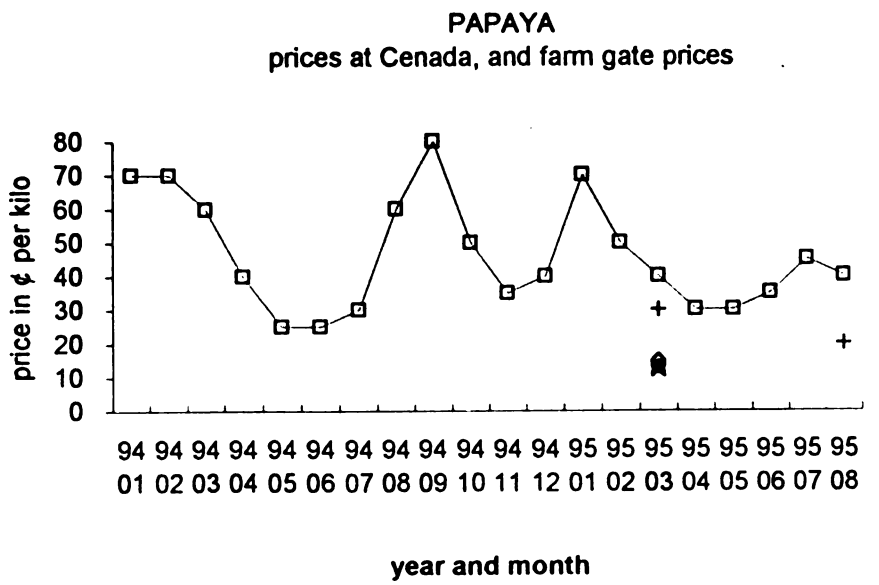
Figure 4.3: Farm-gate prices and CENADA prices for plantain (January 1994 -August 1995)



Source: farm survey, 1995 and Department of Price Information, CNP

CENADA price fluctuates considerably during the year. Farm-gate prices are roughly 50 % of the CENADA price.

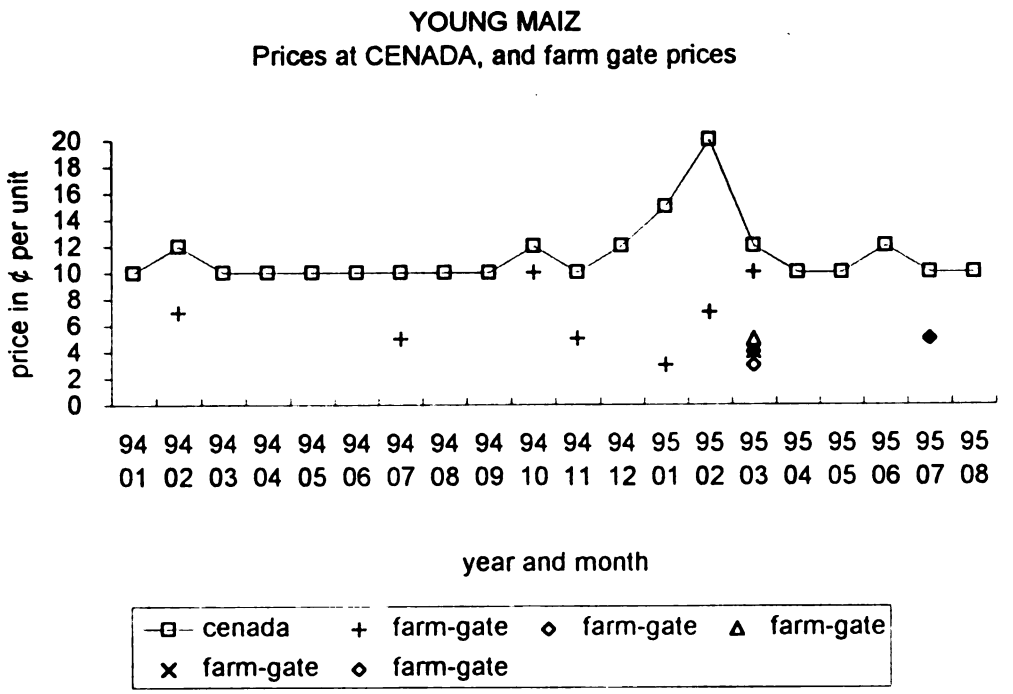
Figure 4.4: Farm-gate prices and CENADA prices for papaya (January 1994 -August 1995)



Source: farm survey, 1995 and Department of Price Information, CNP

Prices of papaya at the CENADA fluctuate considerably over time. Farm-gate prices account for about 40 % of the CENADA price.

Figure 4.5: Farm-gate prices and CENADA prices for young maiz (January 1994 -August 1995)



Source: farm survey, 1995 and Department of Price Information, CNP

Since returns from dry maize currently are very low these days because maize no longer receives price support, farmers prefer to sell young maize. Maize shows a stable price pattern during some months of the year with a peak during the first months of the year. Farm-gate prices fluctuate between ¢4 and ¢10 per unit, while CENADA prices fluctuate between ¢10 and ¢20 per unit.

The data seem to show a rough relation between CENADA price and farm-gate price as mentioned by the farmers in the survey. Differences in farm-gate prices probably depend partly on distance from farm to the main tarmac road.

Available farm- gate data on plantain, cassava, maize, papaya and coconut were used to plot prices at CENADA against prices at farm-gate of all products (Figure 4.6). A division in five zone is developed, according to their distance from the main road (Table 4.4).

Table 4.4 Distribution of farms among zones

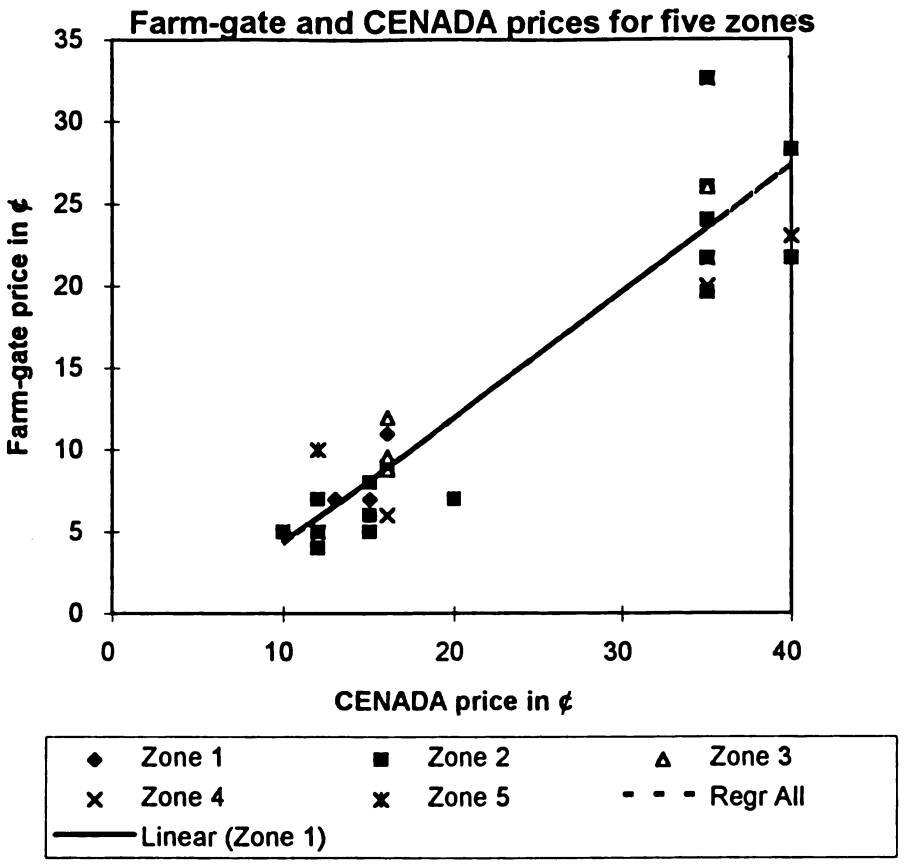
Zone	Distance from main road	Nr of farms
1	≤ 5	10
2	≤ 10	22
3	≤ 20	6
4	≤ 30	5
5	> 30	3

The number of observations for zone 1 and 2 accounts for 61% of the total observations, indicating that crop cultivation and selling primarily takes place close to the main road (Table 4.4).

The following linear regression model for all zones together was executed to explain relation between farm-gate and CENADA prices (Figure 4.6):

Farm-gate price = $\alpha_0 + \beta_0 *$ CENADA price

Figure 4.6:



Source: Farm survey, 1995 and Department of Price Information, CNP

According to the assumption that farm-gate prices decrease with distance, farms that are located close to the main road should be located above the regression line while farms that are located relatively far away from the main road are likely to be bellow the trend line. In addition, the above mentioned regression model was executed for each of the individual zones (Table 4.5).

Table 4.5 Linear regression results on economic zones

	N	intercept	CENADA price	R^2
All Zones	46	-3.36	0.769	0.87
Zone 1	10	-3.02	0.746	0.48
Zone 2	22	-4.98	0.811	0.90
Zone 3	6	-3.03	0.829	0.95
Zone 4	5	-5.36	0.821	0.78
Zone 1	3	-	-	-

Source: Farm survey, 1995 and Department of price information, CNP

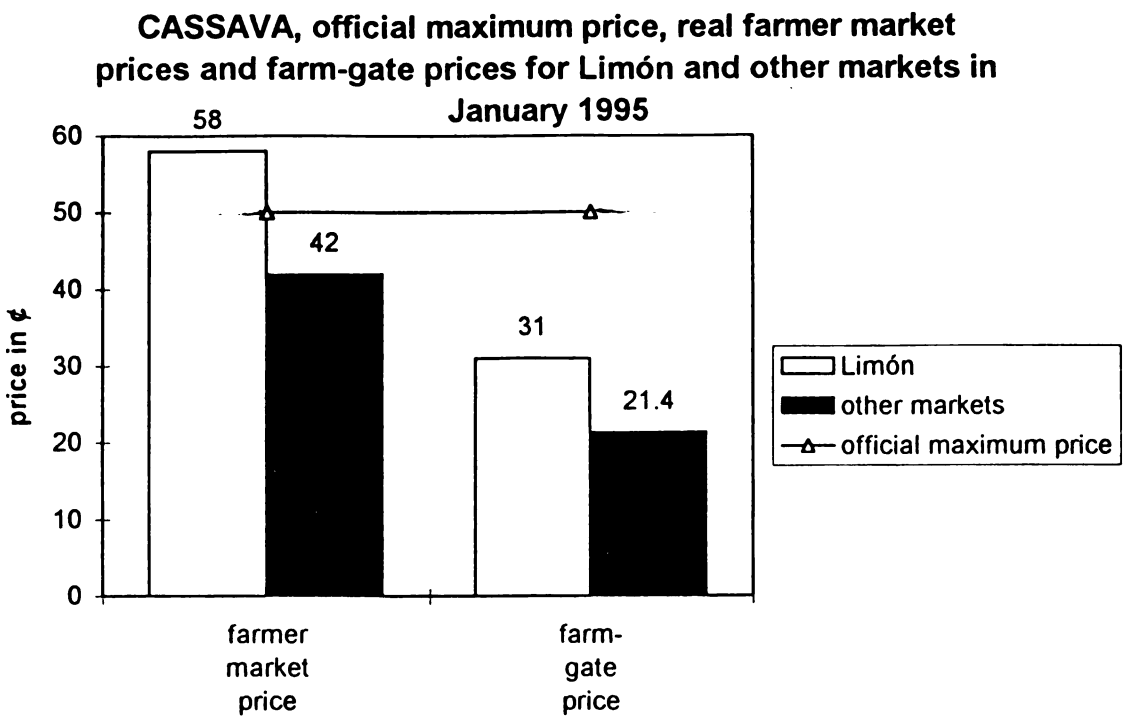
There exists a strong relationship between farm-gate and CENADA prices for all zones together. A comparison of the regression coefficients of the separate zones indicates that the assumption that farm-gate price decrease as with increasing distance to the main road, is not proven by the available data on farm-gate prices (Figure 4.6 and Table 4.5).

4.3.2 Results on farmer markets

Visits to farmer markets were made between the end of December 1994 and the beginning of January 1995. Twenty-two farmers were interviewed regarding selling prices at the feria and farm-gate prices in the region.

For cassava, plantain, young maiz, papaya and cocoyam, a price analysis was executed in which the selling price at the farmer markets is compared to the price farmers said they received at the farm-gate. In addition, the official national determined maximum selling price is presented. In the analysis the market of Limón is presented separately from the other markets; prices in Limón are generally higher because Limón is the most urbanised city of Atlantic Zone, with a higher demand for fresh products than other parts of the Atlantic Zone. In addition, in the county of Limón only a relatively alternative products are grown because of the abundance of banana plantations.

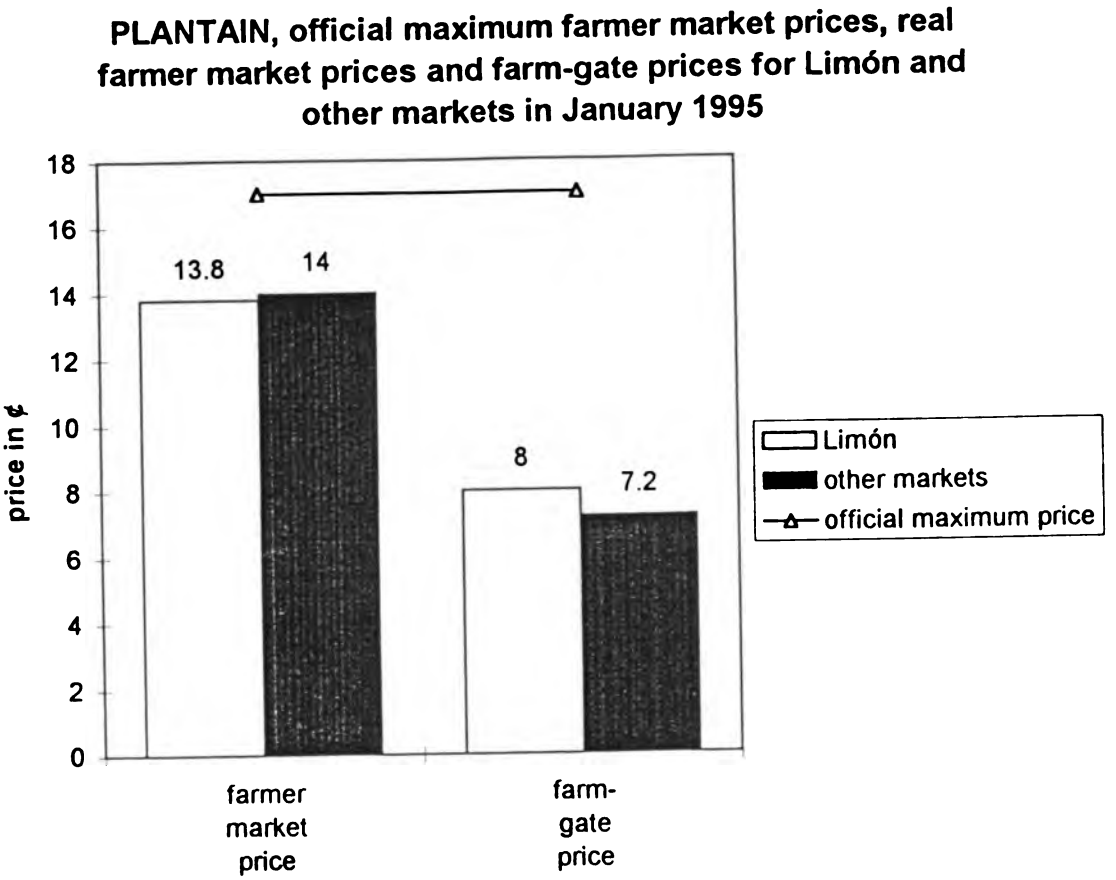
Figure 4.7:



Source: Farmer market survey, 1995 and Department of Price Information, CNP

Farm-gate prices and selling prices for cassava are higher in the Limón market than in other farmer markets (Figure 4.7). Farm-gate price for all markets is 53% of selling price.

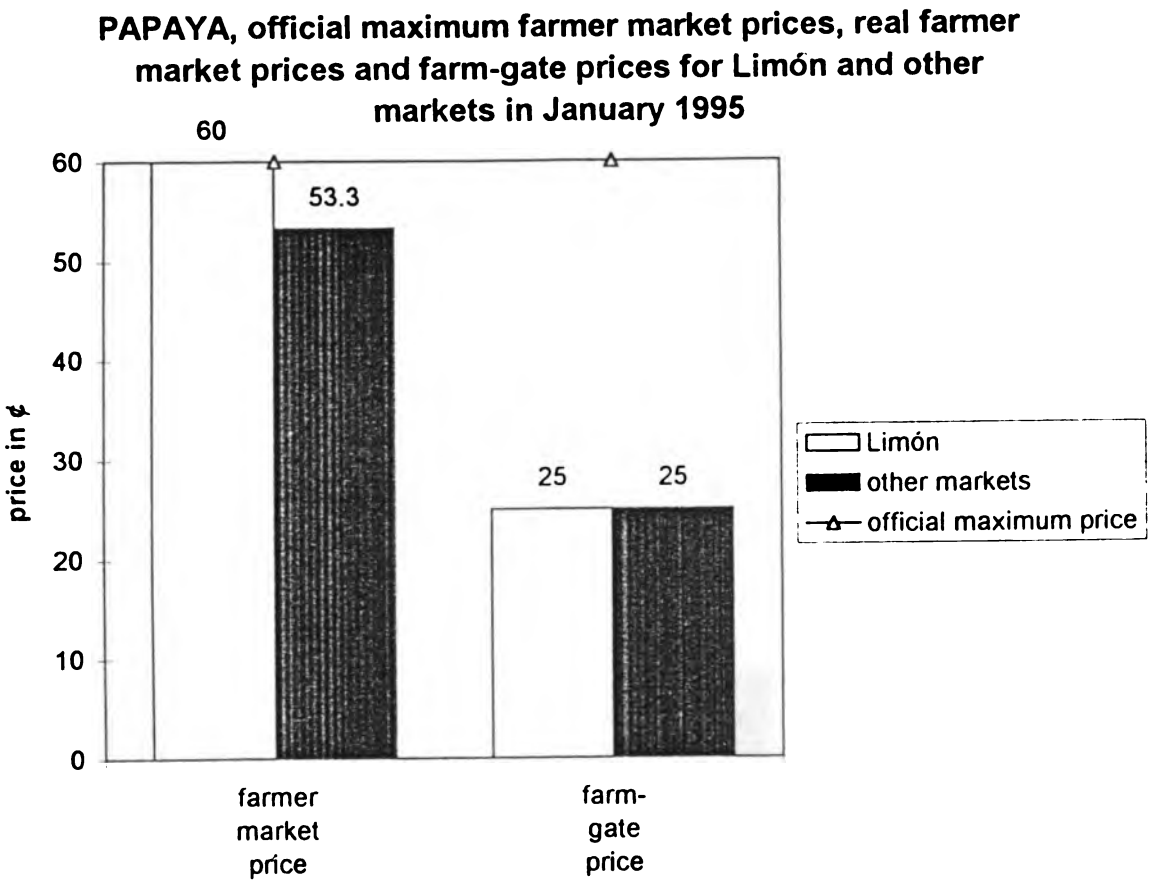
Figure 4.8



Source: Farmer market survey, 1995 and Department of Price Information, CNP

Farm-gate prices and selling prices for plantain in all markets are at a similar level, with the farm-gate price being about 55% of the selling price at the farmer markets (Figure 4.8). Selling prices remain under the maximum farmer market price.

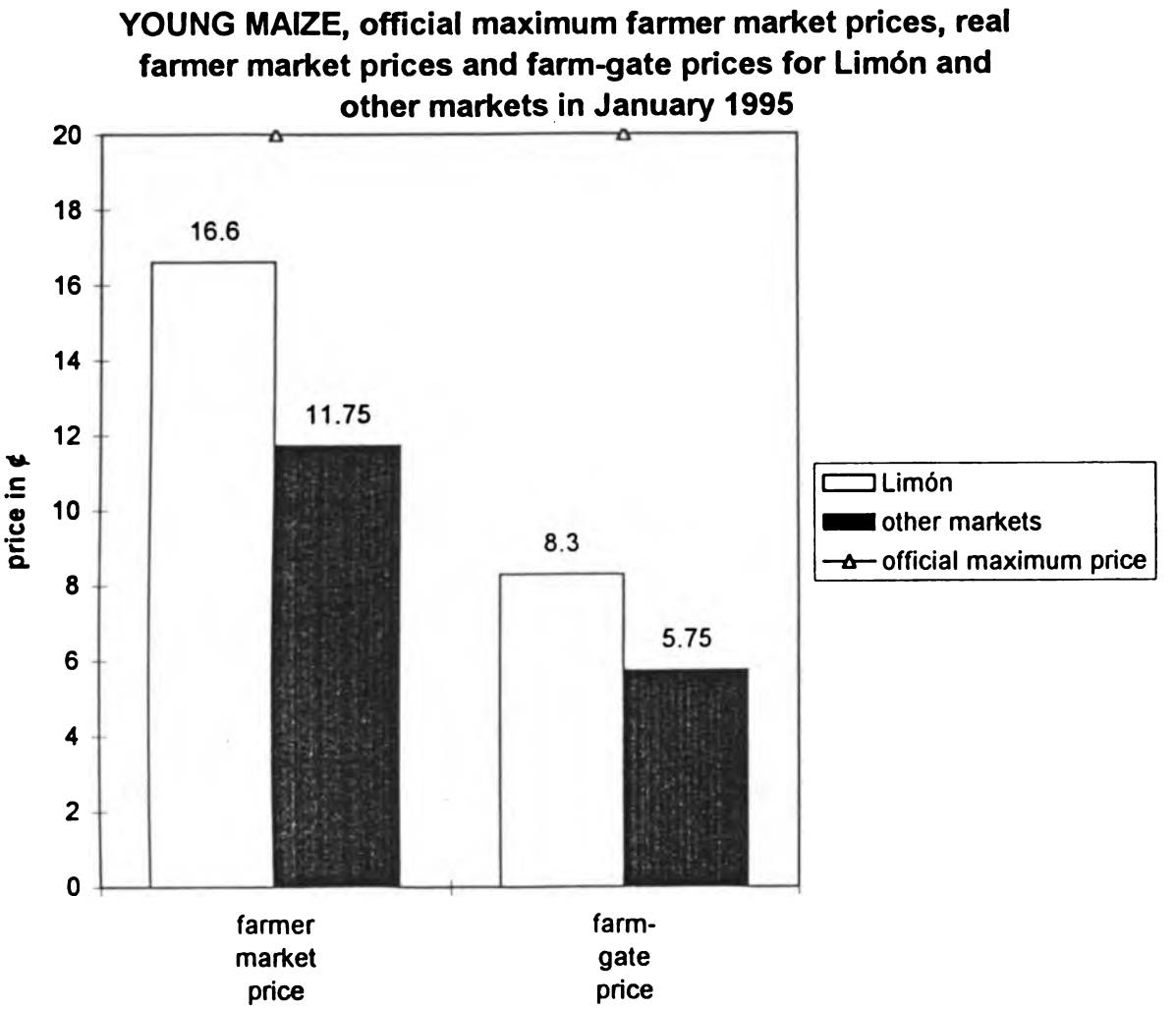
Figure 4.9



Source: Farmer market survey, 1995 and Department of Price Information, CNP

The selling price at the farmer markets does not differ much from this maximum price. Farm-gate price only account for 40- 45 % of the selling price at the markets. The perishability of papaya is the main reason for the relatively high marketing margin for papaya.

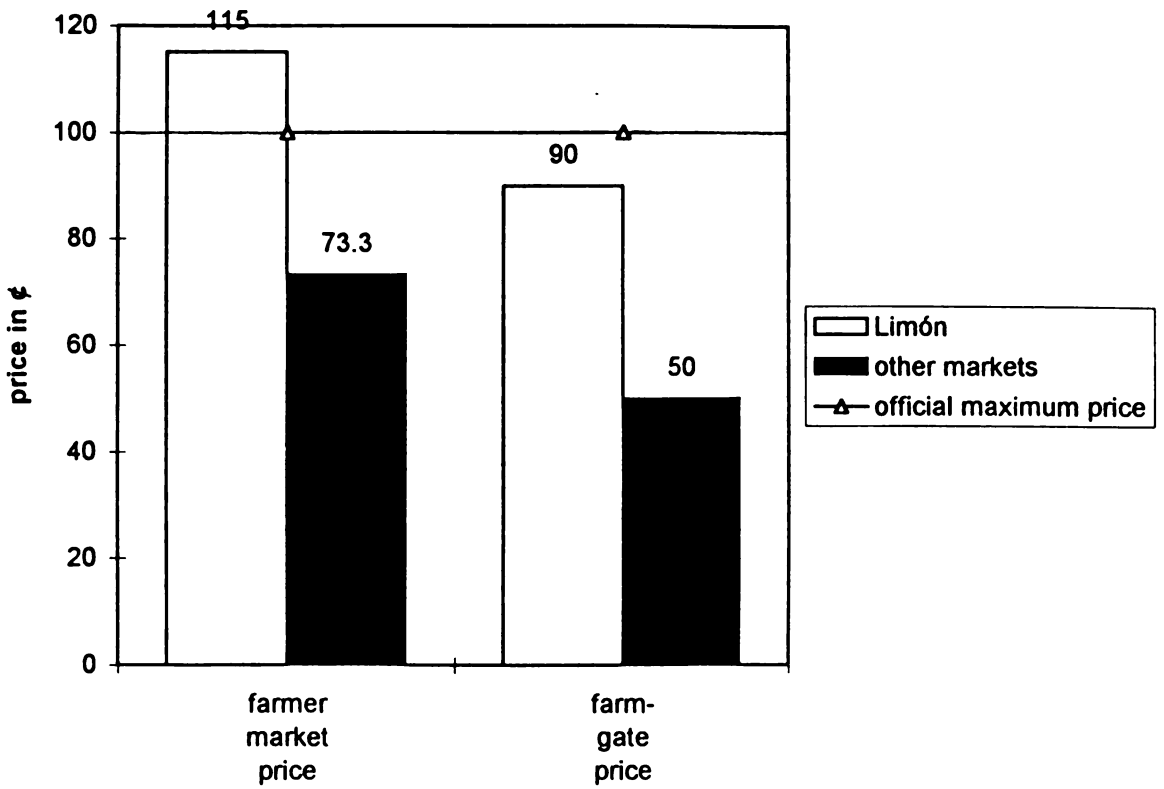
Figure 4.10:



Source: Farmer market survey, 1995 and Department of Price Information, CNP

Young maiz is sold at farmer markets at a price below the maximum farmer market price (figure 4.10). Although farm-gate prices and selling prices are higher in the Limón market, the farm-gate price is 50 % of selling price at the local market.

Figure 4.11: **COCOYAM, official maximum farmer market prices, real farmer market prices and farm-gate prices for Limón and other markets in January 1995**



Source: Farmer market survey, 1995 and Department of Price Information, CNP

Cocoyam is sold at Limón for a price that is higher than the maximum nationally determined price. The farm-gate price is 70 to 78% of the selling price at the local markets. Therefore cocoyam seems to give a smaller marketing margin for those who sell at the markets.

Farmers offering their products at the local farmer markets receive a price that is 30 to 60 % higher than those who sell at the farm-gate. From the higher marketing margin, they have to pay a small contribution for hiring a space and cleaning of the area paid to the administrator. Costs of transport of their products can be a relatively high for those farmers that do not own a vehicle. Although farmers are in generally content with the revenues from the local markets, they mention seasonal problems of oversupply of certain products. Farmers producing a wide variety of products while living close to the farmer market are likely to gain most from selling at the market. During field visits, however, farmers reacted quite reserved on the possibility to sell at

a farmer market. In the Atlantic Zone farmers are not used to sell their produce directly to consumers and prefer to sell the whole quantity at once.

Table 4.6: Price comparison of selling prices at the local farmer markets, CENADA prices, and farm-gate prices for several products

	Limón farmer market				other farmer markets			
	N	selling price relative to official maximum price	selling price relative to CENADA price	farm-gate price relative to CENADA price	N	selling price relative to official max. price	selling price relative to CENADA price	farm-gate price relative to CENADA price
cassava	5	1.16	1.45	0.775	5	0.84	1.05	0.535
plantain	4	0.82	0.93	0.53	5	0.81	0.92	0.48
young maize	3	0.83	1.10	0.55	4	0.58	0.78	0.37
papaya	1	1.00	0.85	0.35	3	0.88	0.76	0.36
cocoyam	2	1.15	-	-	3	0.73	-	

Source: Farmer market survey, 1995 and Department of Price Information, CNP

In general, selling prices at farmer markets remain below the maximum farmer market price (Table 4.6). In Limón, however, most products are sold for higher prices than in the rest of the Atlantic Zone. Cassava and cocoyam form an important part of the diet of the local population which has strong Caribbean influences and therefore exercise a high demand for these products. Comparing wholesale prices at CENADA with selling prices at local farmer markets, it is obvious that cassava is sold for a price that exceeds the CENADA price. An explanation might be that at the CENADA especially large quantities are offered, while at the markets only small quantities are sold. Young maize in Limón also is sold for a price that exceeds the CENADA price. Again the high demand in Limón in combination with the relatively difficult cultivation possibilities might explain this high percentage. In the region outside Limón, farm gate prices are 30 to 50 % of CENADA prices, corresponding to the results from the farm survey (paragraph 4.3.1).

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Appendix Ia: Farm survey

ENCUESTA PARA UN ESTUDIO REGIONAL DE PRECIOS EN LA ZONA ATLANTICA

WF1.dbf:

Número de encuesta: **IDENTITY**
Codigo de lugar: **FINLUGAR**
Nombre de agricultor: (Usted no necessita de decir su nombre): **NOMBRE**
Fecha: **FECHA**
Canton: **CANTON**
Distrito: **DISTRICT**

Tierra
Número de parcelas: **TNUMER**
Tamaño de la finca en total: **THECTA**

Qué tipo de suelos tiene Usted en ha.?
- tierra negra, fértil, bien drenada: **TFBD**
- tierra suamposa, mal drenada: **TFMD**
- tierra roja, bien drenada, infertil: **TIBD**

Usted usa/ ocupa terrenos en arrendamiento, prestades o alquila? si/no **TELALQ**
Cuantas hectáreas ? **TELHA**

agricultura	.....ha	tipo de suelo :	FBD	FMD	IBD
pasto	.....ha	tipo de suelo :	FBD	FMD	IBD
bosque	.....ha	tipo de suelo :	FBD	FMD	IBD
maiz	.....ha	tipo de suelo :	FBD	FMD	IBD
ñame	.....ha	tipo de suelo :	FBD	FMD	IBD
yuca	.....ha	tipo de suelo :	FBD	FMD	IBD
	TELUSO	**TELSOIL**			

Cómo paga Usted por estas hectáreas? **TELPAGO**
- por ha., por mes
- por ha. por año
- por ciclo
- por animal por mes

Cuanto cuesta? **TELCOL**

Hay terrenos suyos que son alquilados por otros agricultores? si/no **TOTRALQ**

Cuantas hectáreas? **TOTHA**

agricultura	.....ha	tipo de suelo :	FBD	IMD	IBD
pasto	.....ha	tipo de suelo :	FBD	IMD	IBD
bosque	.....ha	tipo de suelo :	FBD	IMD	IBD
maiz	.....ha	tipo de suelo :	FBD	FMD	IBD
ñame	.....ha	tipo de suelo :	FBD	FMD	IBD
yuca	.....ha	tipo de suelo :	FBD	FMD	IBD
TOTUSO			**TOTSOIL**		

Cómo pagan ellos por el alquile? **TOTPAGO**
- por ha, por mes
- por ha por año
- por cyclo
- por animal por mes

Cuanto cuesta? **TOTCOL**

Titulación de la tierra

Usted tiene algún documento de propiedad de la finca? si/ no **TITULO**

WF2.dbf:

Crédito

IDENTITY

Durante el año 1994, cuáles préstamos agropecuario de bancos , otras instituciones de crédito tenía Usted o algún otro miembro de su familia? si/no **CREDIT**

	Operación
institución, organización que dió el préstamo?	**CBANCO**
Lugar en que se ubica esa institución	**CLUGAR**
Para que dijo Usted que iba a usar el préstamo? (cultivo, ganado)	**CUSO**

Monto del préstamo	**CMONTO**
Cuántos tueron los gastos para obtener el crédito? (comisión, inspección, timbres, etc)	**CGASTO**
Cuál fue la fecha de la aprobación del crédito?	**CFECHA**
Cuál fue el plazo de pago del préstamo?	**CPLAZO**
Por cada cuantos meses paga Usted pago y interés?	**CPCMES**
Cuánto era el interés al inicio del crédito?	**CINTER1**
Cuanto es el intéres ahora	**CINTER2**

WF3A.dbf:

IDENTITY

Cuántas personas familiares trabajan con Usted?: **FNUMB**

personas, nr	**PERSON = 1**	**PERSON = 2**	**PERSON = 3**	**PERSON =4**
Edad de person	**FEDAD**	**FEDAD**	**FEDAD**	**FEDAD**
Tiempo dedicado en el trabajo de la finca - perm.tiempo completo - perm.tiempo parcial - ocasional	**FTIEMP**	**FTIEMP**	**FTIEMP**	**FTIEMP**

WF3B.dbf:

Ingresos fuera de la finca, Off-farm

IDENTITY

Trabaja Usted o sus demás familiares fuera de su finca? si/no: **OFFARM**

personas	PERSON = 1	PERSON =2	PERSON = 3	PERSON= 4
Cuál es el tipo de trabajo?	OFTRAB	OFTRAB	OFTRAB	OFTRAB
Cuál es la distancia (km) hasta el trabajo?	OFDIST	OFDIST	OFDIST	OFDIST
Tiempo dedicado fuera de la finca - perm.tiempo completo - perm.tiempo parcial - ocasional	OFTIEM	OFTIEM	OFTIEM	OFTIEM
Forma de pago - por hora - por día - por 15 dias - por semana - variable	OFPAGO	OFPAGO	OFPAGO	OFPAGO
Cuanto es el salario fuera de la finca?	OFCOL	OFCOL	OFCOL	OFCOL

WF3C.dbf:

IDENTITY

Usted contrata peónes? si/no **PEON**

	NRPEON = 1	NRPEON = 2	NRPEON = 3	NRPEON = 4
Tiempo dedicado en la finca - perma. tiempo completo - perm. tiempo parcial - ocasional	**PTIEMP**	**PTIEMP**	**PTIEMP**	**PTIEMP**
Qué tipo de trabajo le hacen? Agrícola/Ganaderia	**PTRAB**	**PTRAB**	**PTRAB**	**PTRAB**
Como es el forma de pago? - por hora - por día - por 15 dias - por mes	**PPAGO**	**PPAGO**	**PPAGO**	**PPAGO**
Cuánto le cuesta/ Cuanto es el salario?	**PPCOL**	**PPCOL**	**PPCOL**	**PPCOL**

WF4.dbf = transporte, flete

Nrtrans = 1 refers to transport of inputs from the shhop to the farm
TRLUGAR refers to the place where the output is brought. Codes of TRLUGAR can be found in appendix 2 : Codigos de lugar

	NRTRANS = 1
Dónde compra usted Fertilizante?	TRLUGAR
Forma de pago por el transporte - no costos de transporte - costo por viaje - costo por saco	TRPAY
Cuanto tonelades tiene el flete/ taxi carga	TRTONS
El costo minimo del flete.	TRCOST1
El costo maximum del flete	TRCOST2
Los costo del flete es exacto.	TRSINGL

Nrtrans 2,3, and 4 refer to transport of output from farm to another place
TRLUGAR refers to the place where the output is brought. Codes of TRLUGAR can be found in appendix 2 : Codigos de lugar

	NRTRANS =2	NRTRANS = 3	NRTRANS = 4
Lugar hasta donde el flete va	TRLUGAR	TRLUGAR	TRLUGAR
Forma de pagar por el flete	TR1PAY	TRPAY	TRPAY
Tonelades de flete/ taxi carga	TR1TONS	TRTONS	TRTONS
Costo de flete mínimo	TR1COST1	TRCOST1	TRCOST1
Costo de flete máximo	TR2COST2	TRCOST2	TRCOST2
Costo de flete exacto	TRSINGL	TRSINGL	TRSINGL

WF5B.dbf = Cultivos

maíz grano, elote cobs, yuca, ñame, nampí, tiquisque, ayote sazon, ayote tierno, banana, plátano, papaya, piña, guanabana, coco, pipa, palmito

	FICULTNR = 1	FICULTNR = 2	FICULTNR = 3	FICULTNR = 4
Cuáles productos vende Usted en la finca, en orden de importancia de ganancias?	FICULT	FICULT	FICULT	FICULT
Qué tipo de compradores vienen a su finca? -intermed. -empacador -organizac. (cual)..... - vecinos	FICOMPR	FICOMPR	FICOMPR	FICOMPR
Cuál es la fecha de la última vez que Usted vendió una cantidad de productos?	FIFECHA	FIFECHA	FIFECHA	FIFECHA
Precio de product vendió en la finca?	FIPREC	FIPREC	FIPREC	FIPREC
Unidad de producto? - unidad - kilo - saco - quintal - racimo	FIUNID	FIUNID	FIUNID	FIUNID

WF5B.dbf = Vende a otro lado que la finca

OLFLETE Paga por flete
1 = no paga porque el tiene vehículo
2 = no paga por otra razones
3 = si pagan

	OLCULTNR = 1	OLCULTNR = 2
Cuáles productos vende Usted en otro lugar que la finca en orden de importancia de ganancias?	OLCULT	OLCULT
Dónde vendío?	OLCOMP	OLCOMP
Cuándo fue la última vez que Usted vendío sus productos en otro sitio?	OLFECH	OLFECH
Cuál es el precio qué Usted recibe en este mercado?	OLPREC	OLPREC
Qué unidad de producto vendió?	OLUNID	OLUNID
Cuantas tonelados de transporte tenía el pick-up o camión?	OLTFLET	OLTFLET
Cuáles son los costos del flete ?	OLPFLET	OLPFLET

WF6.dbf

Ganado

Usted vende ganado? si.. no.. **GANADO**

Qué sistema de ganado tiene Usted en su finca? **GSIST**

Usted tiene pastos mejorados ? si/no **GMEJOR**

Usted paga transporte cuando vende animales? **GFLETE**
- no paga porque el tiene vehiculo
- no pago por que el vende a la finca
- si paga po flete

Que tipo de comprador viene a su finca? **GFICOMP**
- comerciante de ganado
- Coopemontecillos (carnicero)
- vecinos

Más o menos cuantos animales vende usted en una vez? **GNUMVEND**

Lugar donde el vende los animales? **GCOMPRA**
- Subasta Guápiles
- Matadero valle Central
- Plaza Montecillos
- Subasta Santa Ana

Cuál es el precio de flete por viaje? **GPTFLET**

Cuál es el tipo de camion? (tonelades) **GTFLET**

Cuál es el precio de flete por animal? **GPAFLET**

Opinion sobre transporte de ganado? **GMEMO**

Madera

1. Usted vende madera? si/no **MADERA**

WF7.dbf = vehiculo, maquinaria

Usa Usted fertilizantes? no/si **FERTILIZER**

Maquinaria

Usa Usted maquinaria? no/si **MAQUINARIA**

Que maquinaria usa Usted en su finca?	**MTIPO**
Manejo de pago. - propia maquinaria - paga por hora - paga por dia - paga por ha	**MPAGO**
Cuánto cobran?	**MPCOL**

Fletes

Usted tiene algún tipo de vehículo? Si/No **VEHICULO**

- el agricultor vende en la finca, si/no **VENDEFARM**
- el agricultor vende en un otro lado, si/no **VENDEOTRO**

Usted paga algún tipo de transporte? **FIVENDE**
- no paga porque tiene vehiculo
- no paga por otra razon
- si pagan

Appendix Ib: Code book for farm survey

CODEBOOK FARM ENCUESTA

Files are saved under C:\dabase\general\susan\workdir\

WF1	General data, soils
WF2	Credit
WF3A	Familia labor
WF3B	Off-farm labor
WF3C	Peón
WF4	Transporte
WF5A	Finca vende cultivos
WF5B	Otro Lado vende
WF6	Ganado
WF7	Maquinaria, fertilizer, lugar donde vende

WF1.dbf:

IDENTITY	= e.g lucha1 (todas las encuestas)
FINLUGAR	Ubicación de finca (appendice 5.)
NOMBRE	Nombre del agricultor
FECHA	Fecha de encuesta
CANTON	Código del cantón (appendice 6.)
DISTRICT	Código del distrito (ver a appendice 1.)
TNUMER	Numero de parcelas
THECTA	Area total de la finca
TFBD	Número de ha con FBD
TFMD	Número de ha con FMD
TIBD	Número de ha con IBD
TELALQ	El alquila tierra, sí:1 no:0
TELHA	El alquila ...hectáreas, numero de ha.

TELUSO El alquila, uso de la tierra

1 = agricultura
2 = pasto
3 = bosque
4 = maíz 5 = ñame 6 = yuca

TELSOIL El alquila, tipo de suelos

1 = FBD
2 = FMD
3 = IBD

TELPAGO El alquila, forma de pago

1 = por ha. por mes
2 = por ha. por ano
3 = por ha. por ciclo
4 = por animal por mes
7 = otro convenio

TELCOL Costo para alquiler ¢....

TOTRALQ Otros agricultores alquilan de èl, sí:1 no:0

TOTHA ...ha. de tierra que otros alquilan de èl

TOTUSO Otros alquilan de èl, uso de la tierra

1 = agricultura
2 = pasto
3 = bosque
4 = maíz
5 = ñame
6 = yuca

TOTSOIL Otros alquilan, tipo de suelos

1 = FBD
2 = FMD
3 = IBD

TOTPAGO Otros alquilan de èl, forma de pago

1 = por ha. por mes
2 = por ha. por ano
3 = por ha. por ciclo
4 = por animal por mes
7 = otro convenio

TOTCOL El gana por alquilar ¢.....

TITULO Documento de propiedad, sí:1 no:0

WF2.dbf: credito

IDENTITY

CREDIT El usa crédito agropecuario, sí:1 no:0

CBANCO Banco donde se solicita
1 = Banco Nacional de Guacimo
2 = Banco Nacional de Guápiles
3 = FINCA, organizacion de credito
4 = Banco de Costa Rica, Guápiles

CLUGAR Lugar donde está el banco (appendice 5)

CUSO Uso de crédito
1 = agricultura
2 = ganado
3 = bosque
4 = maíz
5 = ñame
6 = yuca
7 = palmito

CMONTO Monto de crédito ¢....

CGASTO Costos de requisitos para obtener el crédito ¢.....

CFECHA Fecha ../../.. cuando crédito fue aprobado

CPLAZO Plazo de crédito en ...meses

CPCMES Pagar cada ... meses

CINTER1 Interés de crédito al inicio del crédito

CINTER2 Interés de crédito en este momento

WF3A.dbf: Familia

F = Familia

IDENTITY

FNUMB ... familiares que trabajan en la finca

PERSON datos sobre primera/secuda/tercera/cuarta persona

FEDAD Edad de persona 1/2/3/4.
1 = 5-10 años
2 = 11-15 años
3 = 16-45 años
4 = viejos

FTIEMP Tiempo dedicado en el trabajo en la finca de persona 1/2/3/4
1 = permanente tiempo completo
2 = permanente tiempo parcial
3 = ocasíonal

WF3B.dbf = off-farm labor

IDENTITY

OFFARM Hay familiares que trabajan fuera de la finca, sí:1 no:0

PERSON datos sobre primera/secuda/tercera\ persona

OFTRAB Tipo de trabajo de persona 1/2/3/.
1 = bananera
2 = peón agricola
3 = peón ganadero
4 = construcción
5 = comercio
6 = gubermental

OFDIST ...km distancia hasta el trabajo

OFTIEM Tiempo dedicado fuera de la finca de persona 1/2/3
1 = permanente tiempo completo
2 = permanente tiempo parcial
3 = ocasíonal

OFPAGO Forma de pago de persona 1/2/3

0 = no salario
1 = por hora
2 = por día
3 = por 15 días
4 = por mes
5 = variable

OFPCOL ....col salario fuera de la finca de persona 1/2/3

WF3C.dbf = peón

P = Peón

PEON El contrata peónes? sí:1 no:0

NRPEON Datos sobre peón 1/2/3

PTIEMP Tiempo dedicado a la finca, peón1/2//3

1 = permanente tiempo completo
2 = permanente tiempo parcial
3 = ocasíonal

PTRABA Tipo de trabajo, peón 1/2/3.

1 = agrícola
2 = ganadería

PPAGO Forma de pago, peón 1/2/3.

1 = por hora
2 = por día
3 = por 15 días
4 = por mes

PPCOL Salario de peón 1/2/3

WF4.dbf: flete, costo de transporte

IDENTITY

NRTRANS Datos sobre flete
1 = datos sobre transporte de fertilizacion/ abono de tienda a finca
2 = datos sobre flete de cultivos de la finca a otro lugar
3 = datos sobre flete de cultivos de la finca a otro lugar
4 = datos sobre flete de cultivos de la finca a otro lugar

TRLUGAR Lugar donde el compra en caso NRTRANS = 1
Lugar por donde el flete va en caso de NRTRANS = 2/3/4
(appendice 5 codificacion de lugares)

TRPAY Forma de pagar
0 = No costos de transporte (amigos o carro propio)
1 = costos por viaje
2 = costo por saco de 50-60 kilo

TRTONS ... toneladas del carro/pick-up/taxi

TRCOST1 ... col de flete, precio mínimo

TRCOST2 ...col de flete, precio máximo

TRSINGL ... col de flete, en caso el respondente sabe un precio exacto

---

WF5A.dbf: Cultivos, el vende a la finca

FI = Cultivos Finca

IDENTITY

CULTNR Datos sobre cultivo 1/2/3/4, (cultivo 1 es el más importante para e;ll agricultor)

FICULT Tipo de cultivo

1 = yuca
2 = name
3 = tiquisque
4 = maíz blanco /seco
8 = pina
9 = palmito
10= chile dulce
11= nampí

5 = maíz elote
6 = papaya
7 = pepino
15 = ayote sason
17 = frijol
19 = naranja
12= pipa
13= plátano
14= ayote tierno
16 = sandía
17= guanabana 18 = cacao
20 = chamol

FICOMP Comprador o lugar por donde van los productos
1 = intermediario
2 = exportador
3 = cooperativa o asociación
4 = hasta ahora no vendió
5 = vecinos
6 = empacador

FIFECH Fecha de la ultima vez vendió

FIPREC Precio de producto vendió a la finca, ...col

FIUNID unidad del producto
1 = kilo
2 = unidad
3 = quintal
4 = saco, (saco = quintal)
5 = java
6 = racimo

FIMEMO memo Otras cosas de importancia

WF5B.dbf = el vende en otro lugar

OL = Vende en otro lugar
IDENTITY

OLFLETE Paga por flete
1 = no paga porque el tiene vehículo
2 = no paga por otra razones
3 = sí pagan

OL1CULT Tipo de cultivo

1 = yuca
2 = name
3 = tiquisque
4 = maíz blanco /seco
5 = maíz elote
6 = papaya
7 = pepino
8 = pina
9 = palmito
10= chile dulce
11= nampí
12= pipa
13= plátano
14= ayote tierno
15 = ayote sason
16 = sandía
17 = café

OL1COMP Lugar donde el vende en específico

1 = feria Guápiles
2 = feria Cariari
3 = feria Síquirres
10 = feria Valle Central
13 = exportador Yucatica
14 = exportador
15 = Borbon
17 = vende en la calle
18 = CNP secador en la Rita
20 =Límon
21 = Guápiles empacador

OLPREC Precio del producto, ...col

OLUNID Unidad del producto

1 = kilo
2 = unidad
3 = quintal
4 = saco
5 = java

OLTFLETE Tipo de flete

1 = 0 - 1 ton
2 = <1 - 2 ton
3 = <2 - 3
4 = <3 - 4
5 = <4 - 5

OLPFLETE Precio del flete

OLUFLETE Unidad del flete

0 = viaje
1 = kilo
2 = unidad
3 = quintal
4 = saco

OLMEMO D Memo,otra cosas de importancia

WF6.dbf: Ganado y madera

G = Ganado

IDENTITY

GANADO Usted vende ganado? sí:1 no:0

GSIST Sístema de ganado

1 = cria
2 = engorde
3 = leche
4 = doble proposíto

GMEJOR Sístema mejorado sí:1 no:0

GFLETE Pago por flete?

1 = no pago por que el tiene vehículo
2 = no pago por que el vende a la finca
3 = sí paga por flete

GFICOMP Tipo de comprador a la finca

1 = intermediario
2 = Coopemontecillos
3 = vecinos

GNUMVEND Número de animales que el vende en una vez

1 = 0 - 2
2 = <2 - 5
3 = <5 -20
4 = <20-50
5 = <50

GCOMPRA Lugar donde el vende

1 = subasta Guápiles
2 = matadero Valle Central
3 = Plaza Montecillos
4 = Subasta Santa Ana

GPFLETE Precio del flete por el viaje

GTFLETE Toneladas de flete

1 = 0 - 1 ton
2 = <1 - 2 ton
3 = <2 - 3
4 = <3 - 4
5 = <4 - 5

GPAFLET Precio del flete por animal

GMEMO Memo, cosas de importancia

MADERA Usted vende madera? sí/no

WF7.dbf = vehiculo, maquinaria y lugar donde el vende

IDENTITY

FERTILIZER El usa fertilizantes, sí:1 no:0

MAQUINA El usa maquinaria en su finca, sí:1 no:0

MTIPO Tipo de maquinaria

1 = chapulin
2 = rastradora

MPAGO Forma de pago

0 = propia maquinaria
1 = por hora
2 = por dia
3 = por ha

MPCOL ....col costos de alquilar/contractar

VEHICULO El tiene vehiculo propio, sí:1 no:0

VENDEFARM El vende cultivos a nivel de finca, sí/no

VENDEOTRO El vende cultivos en otro lugar, sí/no

FIVENDE Lugar donde el vende

1 = vende a la finca
2 = vende otro lado
3 = ambos lados

Appendix II: Farmer market survey

ENCUESTA PARA LOS VENDEDORES EN LA ZONA ATLANTICA

Número de encuesta:
Nombre:
Residencia: *IDENTITY*
Ubicación de entrevista: *TOFERIA*
Guápiles = 1
Cariari = 2
Siquirres = 11
Limón = 9
Batán = 3

Tiene medio propio de transporte: *PRIVATTRA* si=1 no=0,

Costos de flete:

De qué forma paga Usted por el flete?	Cuántas toneladas tiene el vehículo? (en caso TRPAY = 1)	Costs minimos de transporte.	Costs maximos de transporte.
TRPAY 1 = por viaje 2 = por saco de 50 kilo	TRTONS	TRCOST1	TRCOST2

Por que vende Usted a la feria?

.....

.....

Por cultivo, cuál es el precio del producto en unidades, kilos.

	intermediario precio finca	precio feria
1 maíz	.....	.....
2 elote, cobs	.....	.....
3 palmito	.....	.....
4 plátano	.....	.....
5 piña	.....	.....
6 papaya	.....	.....
7 tiquisque	.....	.....
8 yuca	.....	.....
9 ñame	.....	.....
10 guanabana	.....	.....
11 ayote	.....	.....

Appendix III: Cattle auction survey

Encuesta, Subasta Guápiles ,

Fecha..... Nr.....*IDENTITY*

1. Hoy, Usted viene de la Zona Atlántica Norte? si.. no..
   De dónde vienen los animales? cantón.... distrito..... pueblo.....
   cerca de .....*FINLUGAR*
   (indica al mapa)

Datos de transporte:

2. Toneladas de vehículo ....toneladas *TRTONS*

5. El vehículo es propio? *CPROPIA*
   sí =1
   no =0

6 - Los animales vienen de su (o del dueño del vehículo) propia finca? *APROPIA*
   sí =1 no = 0

   - Usted compró los animales a agricultores en el campo, (comerciante) *ACOMPRA*
   sí = 1 no = 0

   - Los agricultores en el campo le pagan el flete. Usted es transportista. *AFLETE*
   sí = 1, no = 0

7. Hoy, Usted transportó animales de cuántos agricultores? ..agricultores *NRAGRI*

8. Flete precios dentro de la Zona Atlántica (sólo para los transportistas de la ZA) Codigo de la subasta:

LE = Lechera MC = Macho crio NO = Novillo RE = Repasto TA = Ternera
TO = Ternero TL = Ternera Leche TO = Toro VA = Vaca VL = Vaquilla Leche
VG = Vaquilla

	Número de animales total	Número de novillas	Número de vacas	Número de terneros /as	Número de toros	Precio de flete ¢/animal	Precio de flete ¢/viaje
animales transp-ortados	ATOTAL	NRNOVI	NRVACA	NRTERN	NRTORO	PANIMAL	PFLETE

Appendix IV: Study area and respondents

Table.. Study areas and number of respondents

	number of farms interviewed
Pococí	
- Tarire	9
- Cayuca	4
- El Indio	9
- Palmitas	3
- San Luis de Jiménez	2
- Bella Vista	2
- Linda Vista de Cocori	1
Total de Pococí	30
Siquirres	
- Carmen	4
- Negeuv	10
- Porton de Iberia	4
Total de Siquirres	18
Matina	
- Matina	3
- Barbilla	3
- 28 Millas	2
- Baltimore	3
Total de Matina	11
Guácimo	
- San Luis	5
- La Lucha	8
- San Geraldo	4
- Argentina	3
- Cartagena	1
- El Hogar	4
Total de Guácimo	25
Total	**84**

Appendix V: Codes of village location, 'FINLUGAR'

CODELUGAR	LUGAR	IDENTITY (in farm survey)
1	Guápiles	
2	Guácimo	
3	Cariari	
4	Rio Jiménez	
5	Angeles	
6	Ticabán	
7	Pocora	
8	La Rita	
9	Limón	
10	Valle Central	
11	Siquirres	
12	Jiménez (Guápiles)	
13	Mola Cariari	
14	Matina	matin
15	Puerto viejo de Sarapiquí	
16		
17	Finca seis, Horquetas	
18	Neguev a (1-8) Milano	negea
19	Neguev b (9-11)El Peje	negeb
20	Carmen	carme
21	La Lucha	lucha
22	San Luis de Guácimo/Cartagena	sluis
23	Argentina	argen
24	San Gerardo	sgera
25	Tarire	tarir
26	Cayuca	cayuc
27	Indio a.(1-4)	indio
28	Indio b.(5-9)	indio
29	San Luis de Jiménez	sljim
30	Palmitas	
31	Bella Vista	vista
32	El Hogar	
33	B-Line	
34	Batán	
35	Pacuarito	
36	Liverpool	
37	Roxana	
38	Campo dos	
39	Cocori	
40	Linda Vista de Cocori	
41		

42			
43	Linda Vista de Siquirres		
44	San Carlos de Cariari		
45	Barbilla	barbi	
46	28 Millas de Siquirres	milla	
47	Baltimore	balti	
48	Humo de la Rita		
49	Culva, Roxana de Guápiles		
50	Cruce Iberia		
51	Porton Iberia	porto	
52	Maryland		
53	Colonia Victoria de Rio Frio		
54	La Marina, Ponderosa		
55	Esperanza de Cariari		
56	Anita Grande		
57	Río Frío, finca dos		
58	El Molino de Guápiles		
59	Río Hondo de Siquirres		
60	La Unión		
61	El Ceibo de Cariari		
62	La Colonia de San Rafael		
63	Toro Amarillo		
64	Rio Blanco		
65			
66	Campo Tres de Cariari		
67			
68	Alegria		
69	El Jardín de Cariari		
70	Iroquios		
71	Quatro Esquinas		
72	Imperio de Siquirres		
73	Pueblo Neuvo		
74	Limbo de Duacari		
75			
76	Palestina (Zent)		
77	Carolina Tica		
78	Guápiles otro lado		
79	La Suerte		
80	La Teresa de Guápiles		
81	La Francia		
82			
83			
84	Santa Rosa de la Rita		
85	Ojos de Agua de Siquirres	86	Cubujugui

Appendix VI: Canton and district codes

	distrito	canton	province
06			Limón
76		Limón	
405	Limón		
77		Pococí	
406	Guápiles		
407	Jimenez		
408	Rita		
409	Roxana		
410	Cariari		
411	Colorado		
78		Siquirres	
412	Siquirres		
413	Pacuarito		
414	Florida		
415	Germania		
416	Cairo		
79		Talamanca	
417	Bratsi		
418	Sixaola		
419	Cahuita		
80		Matina	
420	Matina		
421	Batan		
422	Carrandi		
81		Guacimo	
423	Guacimo		
424	Mercedes		
425	Pocora		
426	Río Jiménez		
427	Duacarí		