TIMBER LOGISTICS IN GALICIA, SPAIN.

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Introduction

Galicia is a Spanish Autonomous region, in the NW corner of the Iberian Peninsula, located between the latitudinal co-ordinates 43 º 45' N and 41º 45' N on the western front of Europe.

In past times there was an abundance of mixed forests, with the oak as the dominant species. From the 17th century onwards the felling of the forests was devastating due to agriculture, grazing and shipbuilding. From 1950´s there has been a continuous growing of dense forest areas, associated with agricultural system crisis and important investments made by forest owners. Data provided by the Third National Forest Inventory highlights the great importance of Galicia's woodland, revealing that there has been a clearly sustainable management in the period 1987-1998 and that more timber was attained despite continued harvesting. The 2.060.453 hectares of woodland and 1.342.222 hectares of dense forests, had experienced a positive evolution in recent years, in surface area (an increase of 379.350 hectares), stocks (increase of 44,85 million m^3) and growth (increase of 3 million m^3/year).

Galician forests due to its productivity are nowadays providing an important raw material to forest and timber industry. Annually more than 6 million m^3 are harvested (almost 50% of the total of Spanish harvests) mainly of pine and eucalyptus. The first-transformation timber industry is represented by large companies of boards and pulp present in international markets, as well as a weak sawmilling sector consisting in a large number of familiar enterprises.

Once that wood production is a clear fact and that industry has reached international importance, the keys for developing Galicia's potentialities in forest sector and timber transformation industry are:

- Forest chain integration, from the forest owner to the industry

- Developing new financial instruments to silviculture and wood harvesting, as well as ensure a transparent wood market.
- And, related to the above mentioned, developing and applying logistics tools and researches than can ensure profitability and effectiveness of timber transportation and industry supply.

The Autonomous Administration is encouraging the development of a timber industry cluster since 1999. In this process Universidade de Vigo is playing an important technical advisor role. Research is being made on the weaknesses and strengths of the timber logistic supply chain to industry from little forest owners. This paper analyses the general framework and the first results of this research.

Characteristics of timber supply chain logistics in Galicia.

Although the following statements try to highlight Galician forest sector, most of them can be applied to the forest sector as a whole, regardless of its geographical location.

Timber, as a raw material for industry, is characterised by its high volume/price ratio, low standardised dimensions, and multiple industrial use potential (pulp, fibreboard, sawnwood).

Timber Industry in areas with a fragmented private ownership pattern, relay in several small and dispersed sources of raw material. Straightforward chains have transformed more towards constellations, as many services are now sourced from so-called third parties, them not directly handling the flowing main product. Timber market is not a transparent market, since all the agents involved have not the same information. In this market size economies have a remarkable role. Nevertheless it is frequent that biggest factories can have bigger problems to deal with their wood procurement and sometimes increases in production are directly related with less capital turnover or weak financial status.

In forest based industries, raw material have less value and need more space to be stock, than other kind of industries. Big timber stock areas at the mill represent an important financial burden for the companies, because they must pay for expensive industrial land to pile low value materials, and causes high inventory costs due to longer throughput times. Nevertheless, reduction of stocks is perceived by companies as an important risk because of the inflexibility of the timber procurement chain. The company is not sure that expected raw material will arrive on time and will

keep the regular pace of consumption. In addition timber supply is (as forest work in general) very seasonal.

Only if the company owns large forest areas that can supply a high proportion of the factory needs mill stocks are reduced. In fact this measure is just a change of mill stocks for forest stocks. But this solution creates another financial burden. Buying (or contracting) forest land, planting, and maintaining forest stands before harvesting, reduces the capital turnover of the company, and with long rotation species, or in regions with high land price, can be unfeasible from the economic point of view.

The timber harvested is usually assorted to fit different industrial processes (pulp, fibreboard, particleboard, fuelwood, sawnwood). This practice creates a number of parallel material flows that are divergent, but with certain interactions (Sjöström 1998). And even after that almost all upstream industries face the logistical problem of measuring the quality of inbound materials and make the optimal classification of the material accordingly to its suitable uses. For the efficiency of the timber market and logistics there is the need to co-ordinate these parallel supply chains from the concept of "*extended enterprise*" (Sjöström 2001).

This is the reason for the following reactions of the market:

- enforcement of timber suppliers companies,
- horizontal co-ordination between upstream industries, or
- horizontal diversification of the upstream industries.

The latter is the case of some Scandinavian companies that have designed optimal multiproduct industrial complexes, that ensures the optimal use of all kind of wood assortments (plywood mill + sawmill + chemical pulp mill + mechanical pulp mill). In Galicia this trend takes place in initiatives as the Santiago complex of *Finsa*, where apart from the fibreboard mill there is a sawmill and a plywoodmill; or the current diversification of *Ence´s* factories, where near each pulpmill, solid wood transformation facilities have been created (plywoodmill in Pontevedra and a sawmill in Navia).

Roundwood transport is made form the forest to the mill according to figure 1. Thus in Galicia almost all of it is trasported to the mill by truck or in some cases by railway. Ship transportation is not usual, except for importing roundwood from south-america, or recently from France after the 1999 windstorms. Figure 2. This means that all the timber harvested in Galicia is transported by truck in some moment.

Truck transport is made with semi-trailers (16,5 m) or trailers (18,75 m) with 2,3 or 4 axis. Traffic Code limitates the gross weight in 40 ton for a 16,5 m long truck. This means that only 20-25 tons of roundwood can be transported in each trip. To move the 6 million m3 annual timber harvest in Galicia almost 300.000 truck trips are neccesary. Trucks usually have a crane for loading and unloading with 100-300 kNm strength range. Most of the trucks make the half of the operating distance unloaded.

Why developing timber logistics now?

Sjöström (2001) admits a lack of logistic research in forest industries, exception made of that in Scandinavian countries. Even in this case the development of this research topic has occurred very recently.

In a scenario of rise in fuel prices and scarcity of workforce in rural areas logistics in timber procurement must play an important role. (figure 3) Otherwise timber price at the mill would become unacceptable high for the companies to pay or the standing timber price would become unacceptable low for the forest owners to sell. These conflicting trends create important logistical tensions.

Ecological concern, is also another driving force for improving timber logistics. Forest Industries are, in general terms, “carbon-friendly industries” if we consider as part of the production process the timber growing and its carbon sink effect. But if forest based industries want to account for this carbon sink, also the fossil fuel consumption of timber transport must be accounted. Thus, timber logistics should manage the more “carbon-friendly” way to supply the industry.

Determining timber transport costs from the existing forest stands. An example of improving knowledge on timber logistics in Galicia.

As a first attempt to understand timber logistics in Galicia, a truck transport cost model has been implemented for eucalyptus stands. The aim of this model is to classify the existing eucalyptus plot, regarding the truck transport cost to the different mills.

In figure 4 a complete scheme of the calculation process is shown. Starting from a road network map, which includes highways, A-roads (those under Spanish national administration), and regional roads, a impedance 250m-pixel map was created. The impedance factor represent the difficulty to move from one pixel to the surrounding ones. The value of impedance was calculated to be proportionally inverse to the average speed of a timber truck in each road type.

The consumption centres selected are those mills that use eucalyptus in theirs industrial process (fibreboardmills and pulpmills), ans well as those points from where eucalyptus timber is transported out from Galicia (railway stations and the Portuguese border). To each consumpton centre a cost map is calculated using, *arcviewÔ 3.2ª, arcviewÔ spatial analyst* and a modification of *arcviewÔ cost distance* extension.

The composition of each individual cost map has been made considering the share of the total eucalyptus consumption of each centre. That hypothesis means that the probability of each tree to end in a certain centre is only related with the share of the total eucalyptus wood consumption of that centre, regardless of which is the closest one. Our experience and the opinion of some timber market experts asked supports that choice, in the case of eucalyptus, because companies do not have defined procurement areas and they trend to procure the timber where it is available.

After this cost-composition process, and starting from the eucalyptus stand map, a relative cost is assigned to each eucalyptus pixel.

Conclusions

There is an important need to develop research in the field of timber logistics in Galicia due to the economical and social importance of forestry for the region and due to the inexistence of any work in this field. Even simple results as the presented ones can base deeper achievements. Nevertheless this example is only the first step that Universidade de Vigo in co-operation with Politechnical University of Madrid is taking towards a more detailed characterisation of timber logistics in Galicia. It is planned to repeat the model, with one more level of road classification (rural and forest roads) and for Pine timber market (that in Galicia comprises more than 100 sawmills apart from the boardmills).

There is also the need for study the economic viability of intermediate yards for the mills to stock most of the roundwood, instead of the big mill yards currently used. This should be very interesting for those firms that own more than one factory.

In the future establishment of new mills it is very important to characteriza timber flows and determine optimum locations.

The above example highlights that the eucalyptus stands with a higher relative cost are those in the north coast of Galicia. That area is also that with the higher productivity according to many studies made.

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Table 1 "Galician eucalyptus wood consumption in each mill"

Id	Mill	Company	Estimated Consumtion (m3 cc)
1	**Ence Pontevedra**	Grupo Empresarial Ence S.A.	560.000
2	**Tafisa Pontevedra**	Tafisa - Sonae	140.000
4	**Finsa Padrón**	Financiera Maderera S.A.	175.000
6	**Finsa Santiago**	Financiera Maderera S.A.	50.000
8	**Tafiber Betanzos**	Tafisa - Sonae	150.000
9	**Fibranor Rábade**	Financiera Maderera S.A.	150.000
11	**Ence Navia**	Grupo Empresarial Ence S.A.	345.500
			1.570.500

Table 2 " % of Galician Eucalyptus consumption"

Consumtion centre	% Volume
Ence Pontevedra	**25,4**
Ence Navia	**15,7**
Torraspapel	**10,6**
Finsa Padrón	**8**
Fibranor (Rabade)	**6**
Tafiber (Betanzos)	**6**
Tafisa (Pontevedra)	**6**
Rottneros	**5,5**
Zicuñaga	**3,4**
Output to Portugal	**2,1**
Finsa Santiago	**2**
Pastguren	**0,6**
Sniace	**0,2**
Other	**8,5**
Total	***100***

Table 3 "Annual eucalyptus wood transportation out from Galicia"

Id	Location	Destination Company	Estimated Volume (m3 cc)
3	**Portuguese Border**	Soporcel Portucel Stora-Celbi	44.000
5	**Railway Station Pontecesures**	Torraspapel Rottneros Zicuñaga Sniace Pastguren Soporcel Portucel	44.000
7	**Railway Station Santiago**		110.000
10	**Railway Station Ferrol**		176.000
12	**Railway Station A Coruña**		44.000
13	**Railway Station Tuy**		66.000
			484.000

Table 4 "Coefficient of Cost Composition"

Id	Location	Coeficient
1	**Ence Pontevedra**	27,16
2	**Tafisa Pontevedra**	6,65
3	**Portuguese Border**	2,22
4	**Finsa Padrón**	8,87
5	**Railway Station Pontecesures**	2,22
6	**Finsa Santiago**	2,22
7	**Railway Station Santiago**	5,54
8	**Tafiber Betanzos**	6,65
9	**Fibranor Rábade**	6,65
10	**Railway Station Ferrol**	8,87
11	**Output to Ence Navia**	17,41
12	**Railway Station A Coruña**	2,22
13	**Railway Station Tuy**	3,33

Source: Llorente (2001), Spanish Railway Public Company (Renfe), González et al. (1998), and the authors estimations

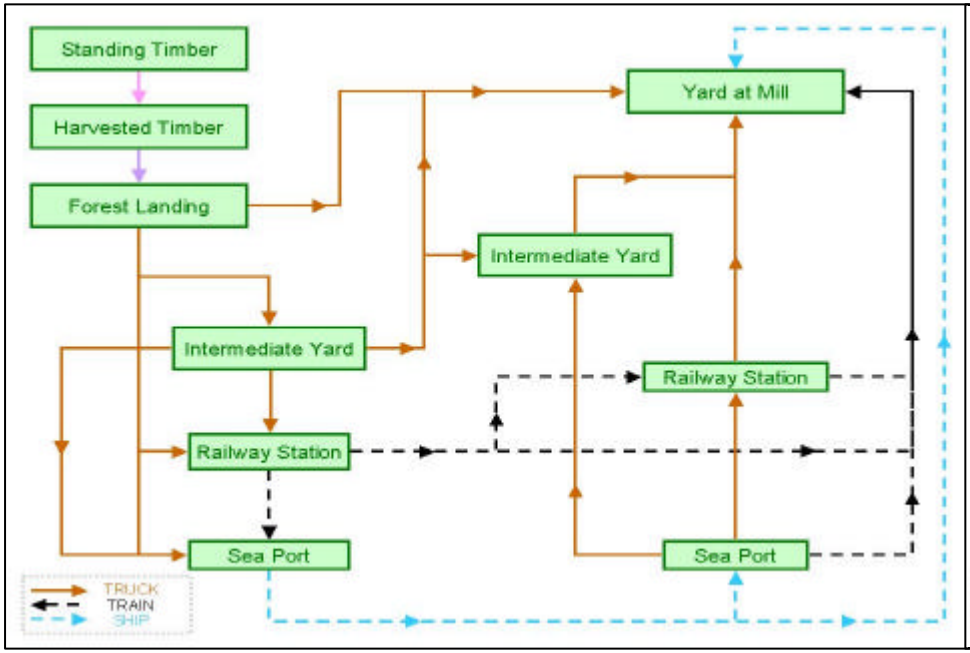

Figure 1: Timber transport

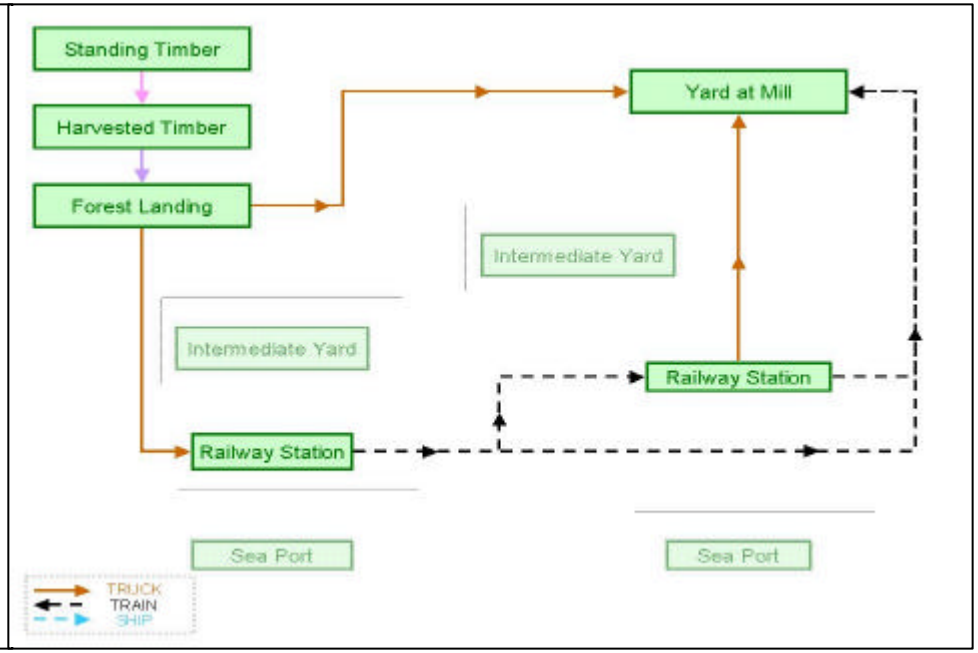

Figure 2: Timber transport pattern in Galicia

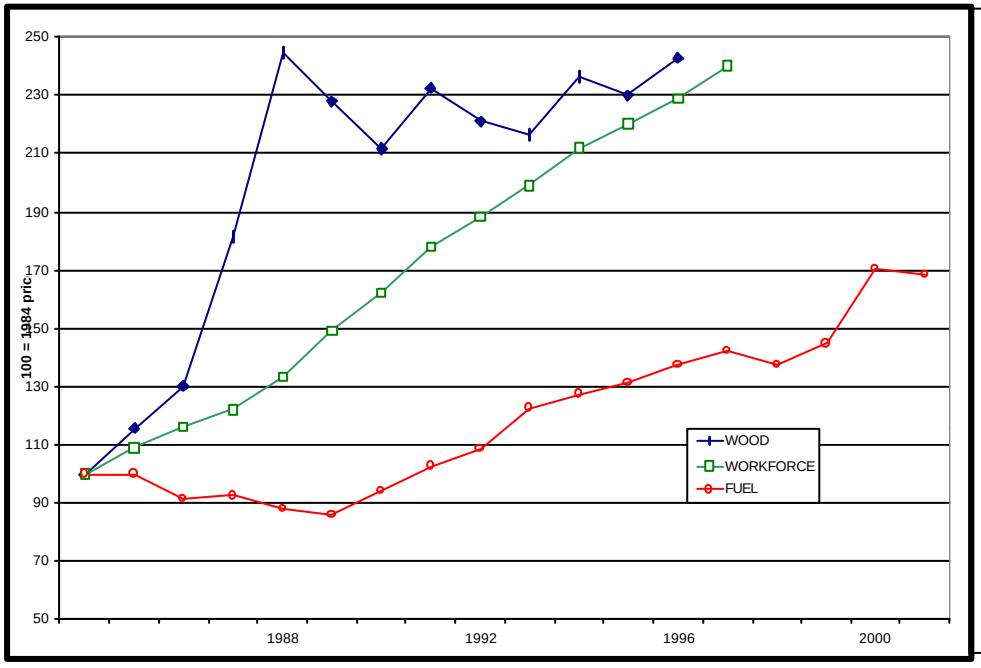

Figure3: Evolution of timber price, workforce price and fuel price

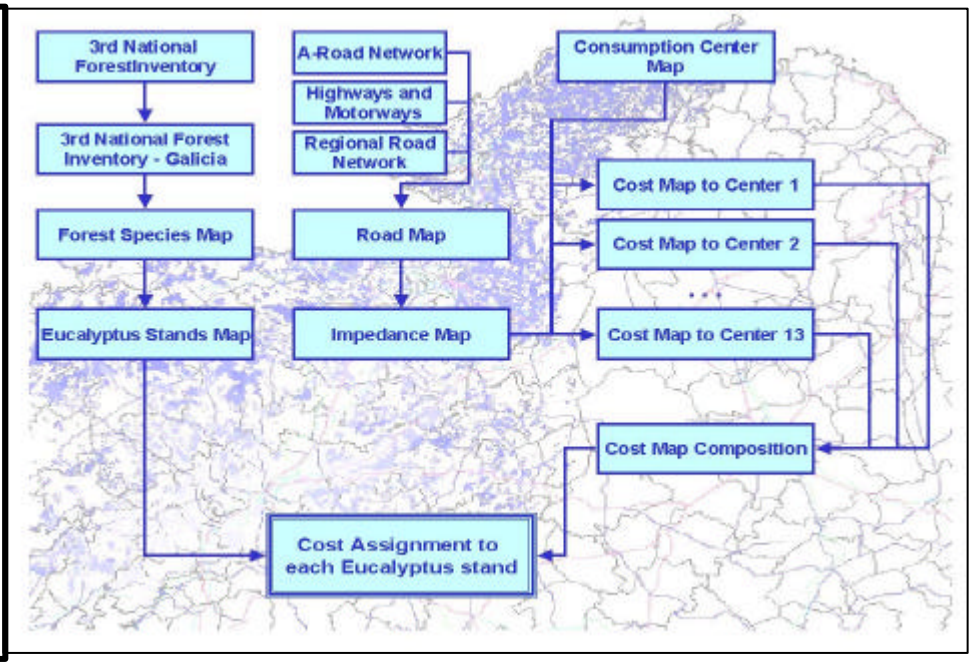

Figure 4: Model for truck transport cost calculation in eucalyptus

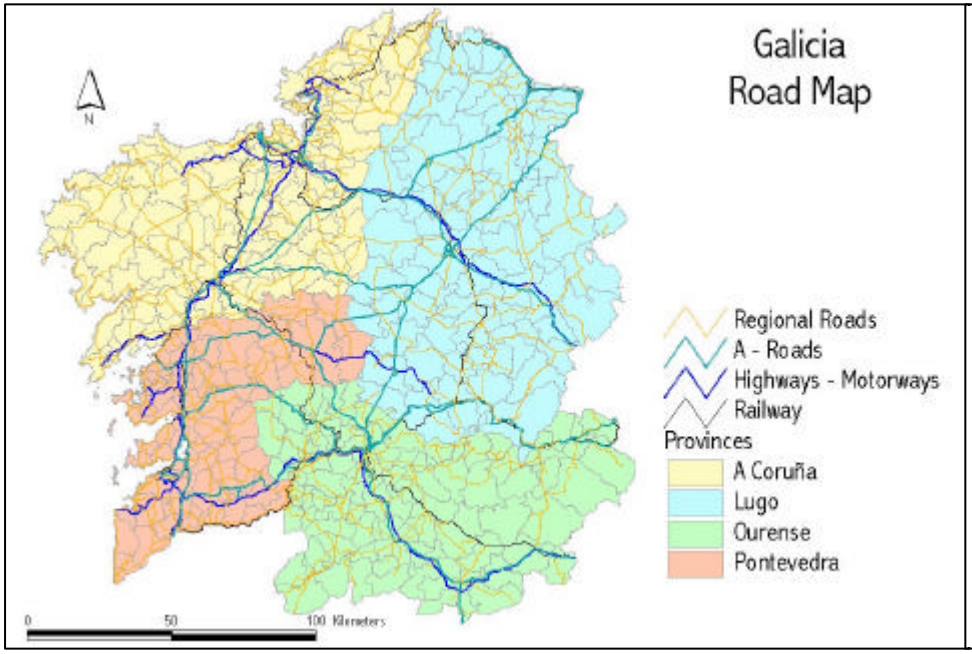

Figure 5: Galician Road Map

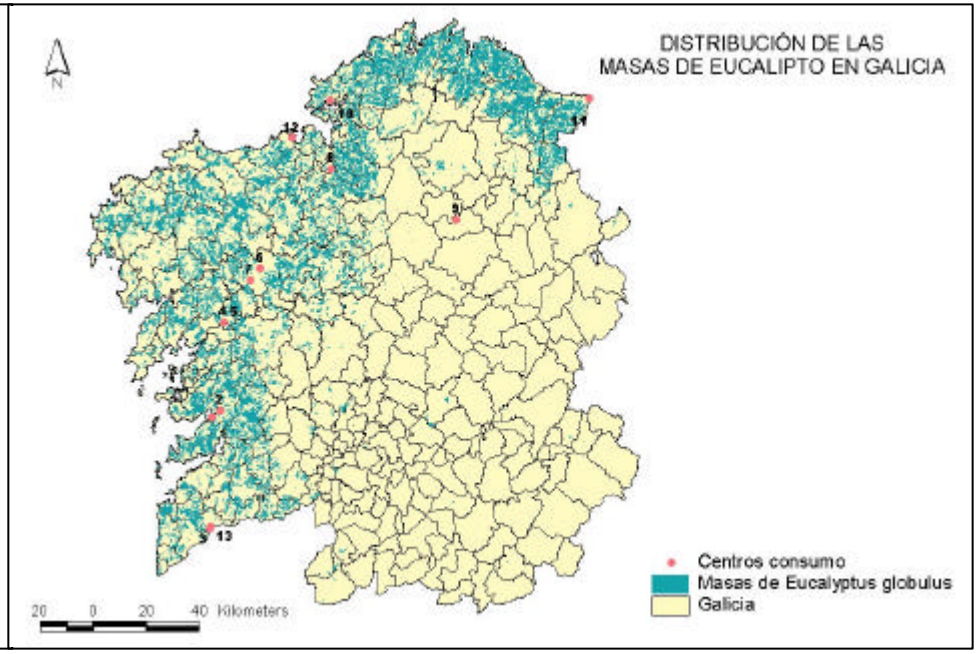

Figure 6: Galician eucalyptus stands and consumption centres

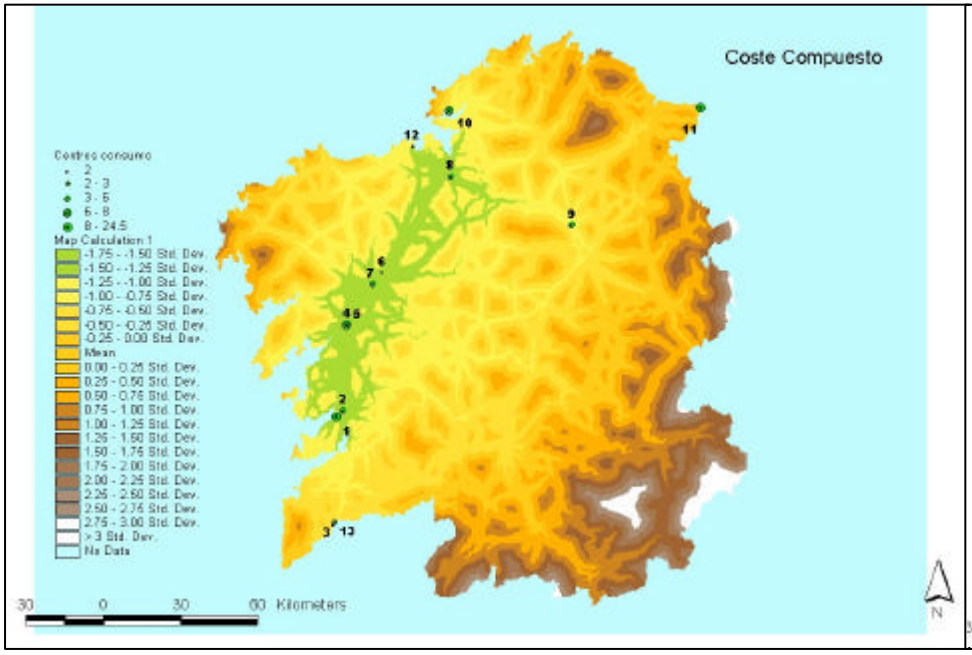

Figure 7: Truck transport Cost Composition

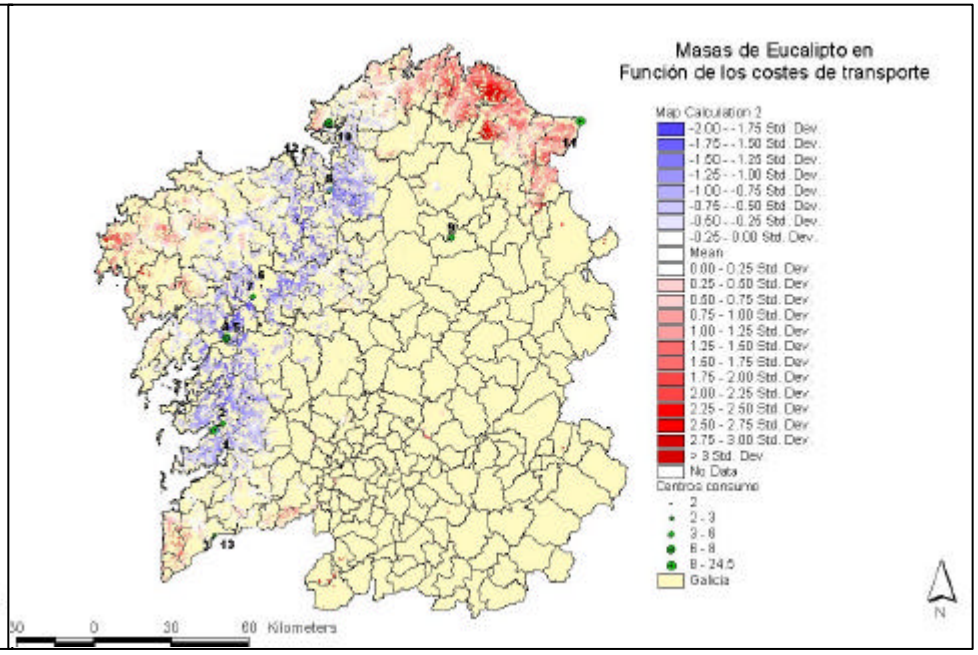

Figure 8: Relative cost for each stand