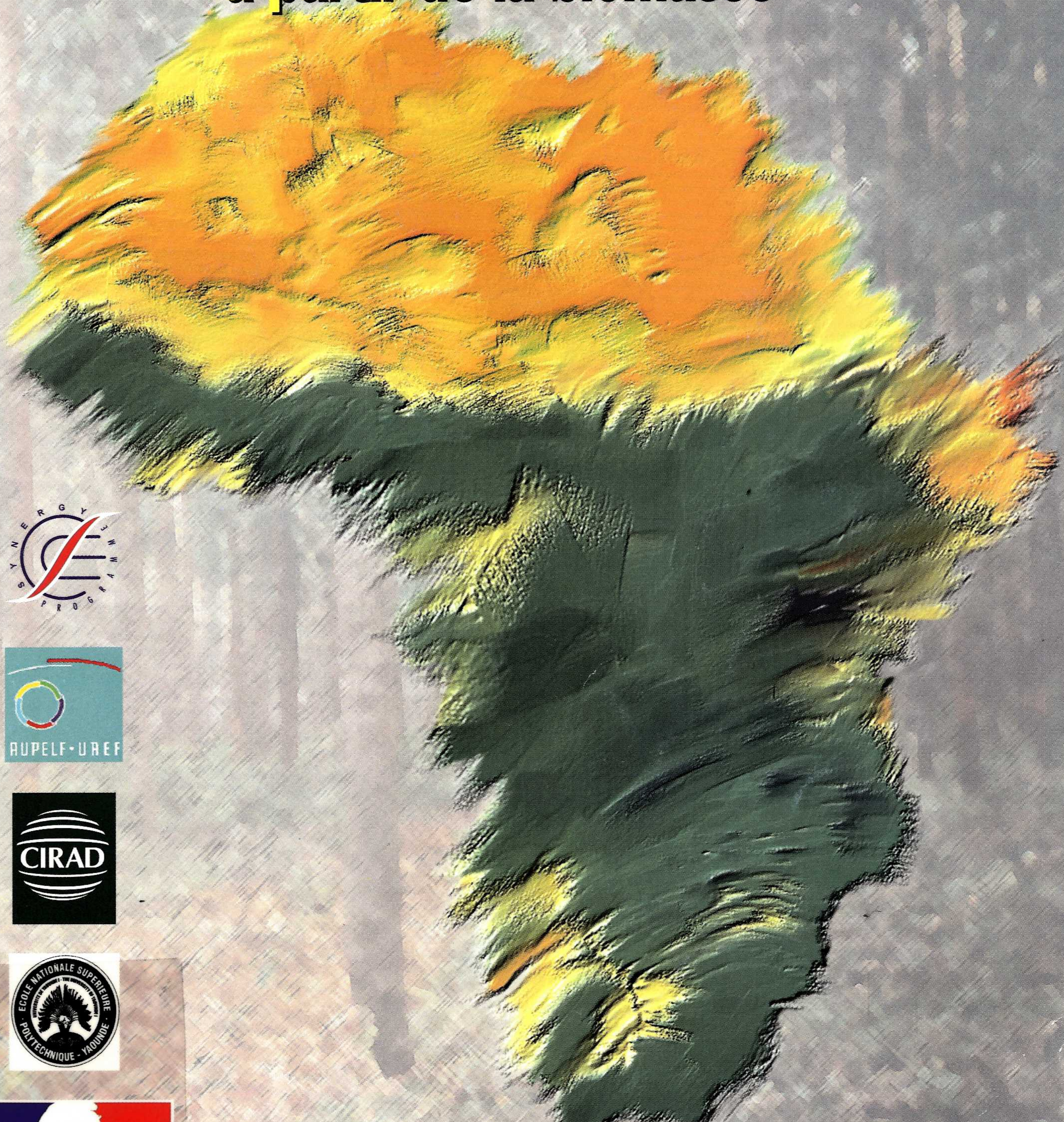
Faisabilité de projets d'électricité rurale décentralisée à partir de la biomasse



Actes de l'atelier régional du 25 au 30 Septembre 2000
YAOUNDE (CAMEROUN)

CIRAD-Forêt

Ecole Nationale Supérieure
de Polytechnique

ORGANISATION ET SUIVI DE L'ATELIER DE FAISABILITE DE PROJET D'ELECTRICITE RURALE DECENTRALISEE A PARTIR DE LA BIOMASSE

YAOUNDE (CAMEROUN) 25 au 30 Septembre 2000

SUMMARY A BIOMASS SUPPLY MODEL FOR ELECTRICITY PRODUCTION IN EUROPE

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Supply curves are used to determine minimum prices at the plant gate required by farmers to supply the corresponding quantity. They can be used by conversion plants to estimate in a realistic way the cost of biomass feedstock related to quantity. The supply curves are used by the conversion module of the integrated bio-electricity decision making model (Bio-Electricity Decision-making - BIELD). Note that these curves are specific to a particular site as they include transport costs and consequently represent the cost at the conversion plant gate.

We can observe that in this case miscanthus results in higher benefit per hectare so it will be prefered to cynara plantation. This selection depends on prices that bio-electricity plant would pay for energy crops. Given that cynara has a higher Low Heating Value (LHV determines energy produced) than miscanthus, it could be profitable for the plant to pay a higher price to the farmer for cynara and this way minimise the cost of biomass feedstock in the total cost of a unit of bio-electricity produced. For this reason supply curves of these two energy crops are generated for all possible combinations of prices. A grid of all possible prices at which energy crops can be sold at the plant gate is constructed (which defines a set *J*). Prices that fall outside this grid are either too low resulting in zero quantities being produced, or too high without any additional stimulating effect. Then, we perform successive conversion model iterations using all possible pairs of prices (p_{cynara} = {30, ..., 65} and $p_{miscanhus}$ = {45, ... , 60} in /t) in order to obtain corresponding quantities produced.

Table 1 : Surplus per hectare from energy crop cultivation

Land unit no: xx	**Cynara.**	**Miscanthus**
Yield	25	50
Production cost	49	48
Harvesting cost	7	6
Transport and storage cost	4	3
Total cost	60	57
Market price	65	60
Producer surplus per ha	**125**	**150**

Table 2 : The grid below is the output of the BIELDsupply model and presents quantities (in t) of cynara produced in the area of study for all possible combinations of cynara and miscanthus prices at the plant gate (/t)

		CynaraPrice					
MiscanthusPrice	Data	30	31	32		34	
50	Sum of CynaraQ	194	194	7268	...	166318	...
	Sum of MiscanthQ	206	206	206	...	206	...
51	Sum of CynaraQ	194	194	7268	...	166318	...
	Sum of MiscanthQ	206	206	206	...	206	...
52	Sum of CynaraQ	194	194	7268	...	166318	...
	Sum of MiscanthQ	206	206	206	...	206	...
53	Sum of CynaraQ	194	194	7268	...	166318	...
	Sum of MiscanthQ	589	589	589	...	589	...
54	Sum of CynaraQ	194	194	7268	...	166318	...
	Sum of MiscanthQ	15371	153. 71	15371	...	15371	...
55	Sum of CynaraQ	194	194	7268	...	166318	...
	Sum of MiscanthQ	36435	364 35	36435	...	36435	...
56	Sum of CynaraQ	194	194	7268	...	166318	...
	Sum of MiscanthQ	36435	364 35	36435	...	36435	...
57	Sum of CynaraQ	194	194	7268	...	166318	...
...	...	...	...	...	...	...	...

Note that these quantities are not determined independently; they take into account cross-price effects between energy crops, as shown in Figure 1a.

In the horizontal axes we have prices (PC and PM stand for price of cynara and miscanthus respectively) whereas quantities of cynara produced are shown in the vertical axis. One can observe that approximately up to 45 /t of cynara no interdependence appears regarding miscanthus price. This is explained by the fact that in this range only cynara in dry land units is profitable to produce.

As miscanthus has to be irrigated there is no competition for this type of land. However for higher prices of cynara when irrigated land units start to find interesting to substitute energy for traditional crops, then competition between energy crops is observed. This is obvious when cynara price is set at higher than 65 /t. In this case, production of cynara reaches more than 500 thousand tons given a miscanthus price of less than 60 /t. When this latter takes values higher than 65 /t, cynara production almost disappears from irrigated land units and it is limited only to the non-irrigated ones. Miscanthus production is shown in the graph below, for the same miscanthus and cynara ranges as previously. This time it is miscanthus quantity that is presented in the vertical axis.

In this graph we can confirm the previous observation as the highest miscanthus quantities are produced for price combinations found at the antipodes of the grid.

In figure 2 total biomass feedstock supply surface for site A is shown dependent on cynara (x axis) and miscanthus (y axis) prices. It is expressed in Tcal and biomass quantity (or its thermal equivalent) supplied at the plant gate at site A and its variations for different levels of cynara and miscanthus prices.

Figure 1a : Supply of cynara (cultivated in irrigated and non irrigated land units) competing with miscanthus for irrigated land

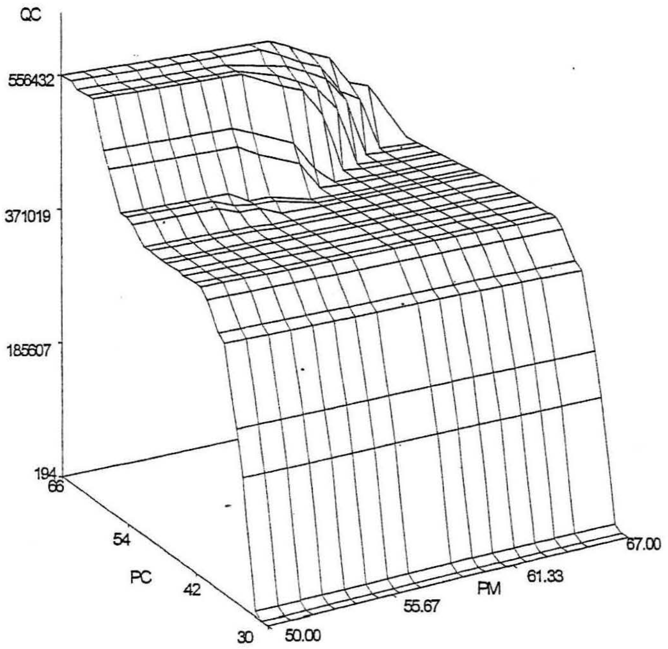


Figure 1b : Supply of miscanthus competing with cynara for irrigated land

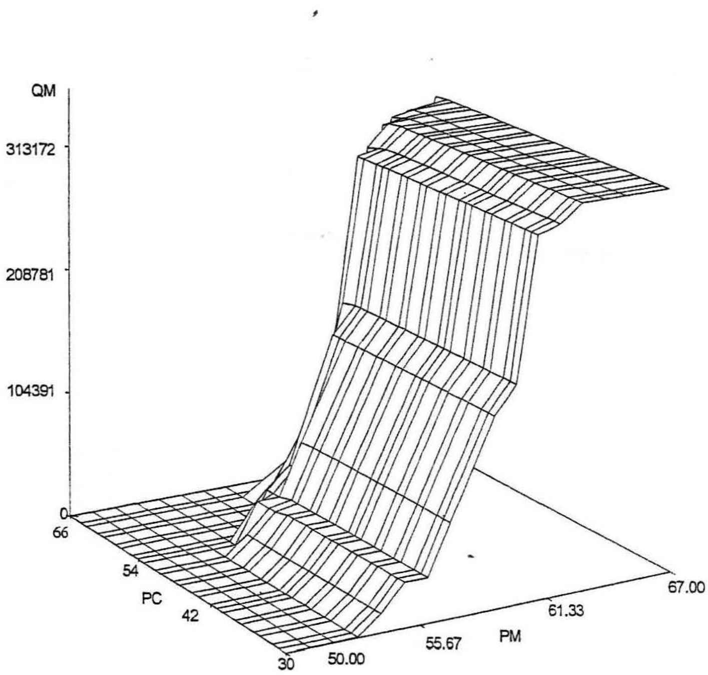


Figure 2 : **Total biomass feedstock supply (both cynara and miscanthus in Tcal)**

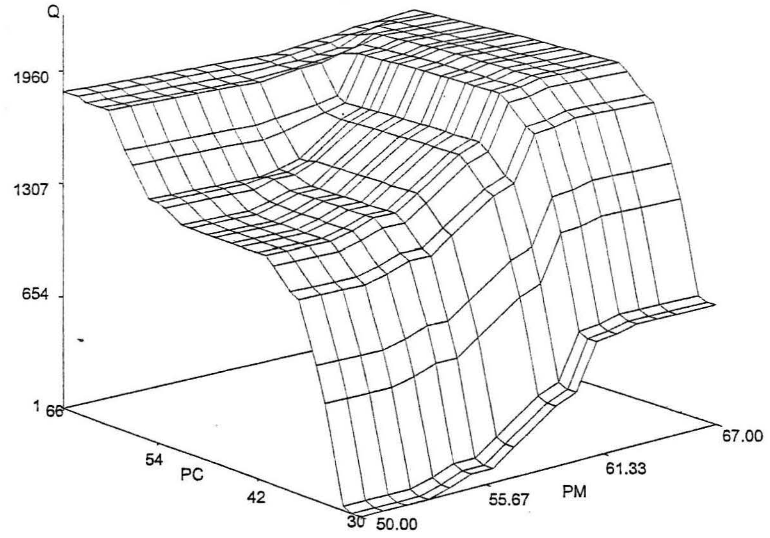
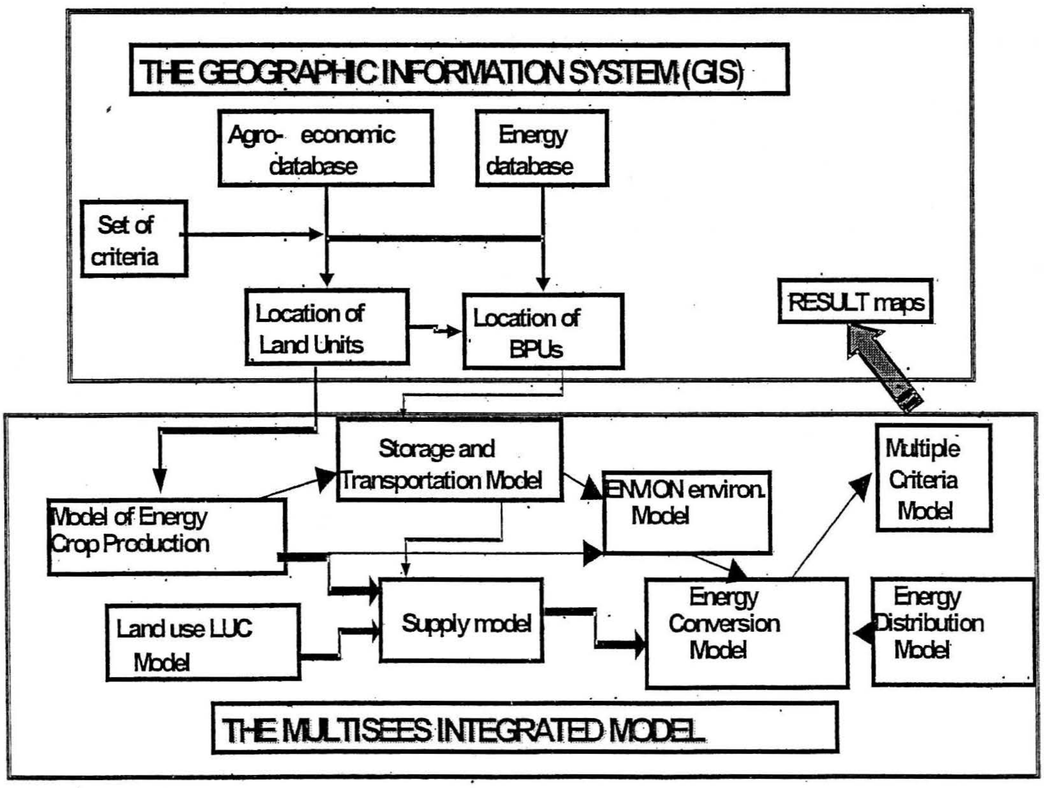


Figure 3 : Data flowchart in the Bio-Electricity Decision-making integrated model[1].



[1] adapted from R.M. Sáez, et al., A Multiple Criteria Decision Tool For The Integration Of Energy Crops Into The Southern Europe Energy System, World Conference on Biomass for Energy and Industry, Sevilla, June 2000 (see ANNEX).

Figure 4 : Integrated model BIELDmc cartographic output example :
Map of the case study area which shows Lands Units that produce biomass feedstock.