Working Paper WP96-4 **November 1996**

Fifth Joint Conference on

Agriculture, Food, and the Environment

Proceedings of a Conference Sponsored by
University of Minnesota
Center for International Food and Agricultural Policy

Università degli Studi di Padova
Dipartimento Territorio e Sistemi Agro-forestali

Agricultural Development Agency - Veneto Region

University of Perugia

University of Bologna - CNR

SESSION VII: SUSTAINABLE DEVELOPMENT OF AGRICULTURE IN METROPOLITAN AREAS

PAPER 3: PERIURBAN AGRICULTURE IN METROPOLITAN AREAS: THE BOLOGNA CASE STUDY

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FOREWORD

This volume contains the papers presented at the Fifth Joint Minnesota/Padova Conference on Food, Agriculture, and the Environment held at Abano Terme, near Padova in Italy, June 17-18, 1996. This conference was organized by the Center for International Food and Agricultural Policy at the University of Minnesota and the Dipartimento Territorio e Sistemi Agro-forestali at the Universitá degli Studi di Padova (University of Padova) under their international collaborative agreement, along with the Agricultural Development Agency - Veneto Region, the University of Perugia, and the University of Bologna - CNR. The first Joint Conference was held in Motta di Livenza, Italy in June 1989, the second in Lake Itasca, Minnesota in September 1990, and the third in Motta di Livenza in June 1992. The Fourth Joint Conference was held in September 1994 at the Spring Hill Center in Minnesota.

This conference focused on topics of mutual interest in the areas of (1) agricultural and resource policy, (2) land markets, (3) the food and agricultural industry, (4) agriculture and the environment, and (5) agricultural production and environmental quality and sustainability. Although the conference was not intended to provide a comprehensive coverage of all the issues, this volume hopefully represents a useful contribution to current understanding and debate in the areas of food, agriculture, and the environment.

Judy Berdahl, secretary for the Center for International Food and Agricultural Policy at the University of Minnesota, assisted with these Proceedings.

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June 17-18, 1996

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Consiglio Nazionale delle Ricerche
CENTRO DI STUDIO SULLA GESTIONE
DEI SISTEMI AGRICOLI E TERRITORIALI
(Ge.S.T.A. - CNR)

PERIURBAN AGRICULTURE IN METROPOLITAN AREAS: THE BOLOGNA CASE STUDY

by

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Fifth Joint Conference on
AGRICULTURE, FOOD AND THE ENVIRONMENT
held at the University of Padova, June 17-19, 1996.

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CONTENTS:

1. THE RESEARCH PROJECT FOR THE AGRICULTURAL WEDGE OF NORTH-EAST

The Emilia Romagna Landscape Plan (ERLP) defines as *agricultural wedges* five areas located in the urban fringe plain of Bologna. The name arises from the strong agricultural characterisation which the wedges maintain in a context of urbanisation. The ERLP points out that new models of integrated sustainable development between urban and rural land should be found and tested in the wedges. An increasing interest is shown by the population for the favourable development opportunities offered by the integration of these areas. In a context of welfare, other options apart from the traditional agricultural productive function are emerging: above all recreational services strictly linked with new a demand for natural landscapes. On the other side greater attention is shown for the environmental impacts of agricultural activity, which is increasingly submitted to more stringent rules on waste, water and soil management.

The research, according to the Province's preferences, is for the moment limited to a pilot-area defined "North-Eastern Wedge", which is bordered to the west by the Motorway Bologna Padova, to the south by the freeway, to the east by the Idice and Savena rivers, to the north by the provincial road n.3. The territory, with an extension of about 9000 hectares, is shared between five communes (Bologna, Granarolo, Castenaso, Budrio and, for a very small part, Castel Maggiore) (figure 1st).

The aim of the research is to study the characteristics of the present agricultural reality (first phase) in order to identify possible future scenarios of sustainable development (second phase).

In greater detail the first phase aims to:

- verify the reception of the EEC regulations no. 2078/92 and no. 2080/92 in the area;
- describe the agricultural activity at farm level;
- analyse the agricultural system.

The previous points have been investigated with different approaches.

A specific survey has been undertaken to investigate the application of the environmental measures in the area.

Interviews have been chosen to investigate the agricultural reality at farm level. Nearly 100 farms, which represent about 15% of the total, have been selected. Data and information about agri-techniques, socio-economic situation, environmental impact, as well

as on future expectations of the farmers are collected through an *ad hoc* questionnaire and direct interviews.

The research group is working with the collaboration of Farmers Associations, co-operatives, contractors, agro-industries involved in the wedge and their activity will be studied in the next future.

The construction of scenarios as well as the study of possible measures to be undertaken by the Province concerns the second phase of the research. At farm level models represent the conjunction between the comprehension of the present reality and the simulation of future scenarios. At territorial level different analyses will be carried out focusing on environmental and socio-economic sustainability of different options.

2. FIRST RESULTS

2. 1 EEC regulations n. 2078/92 and n. 2080/92

As far as the EEC environmental regulations are concerned all the applications presented since 1992 to the Administrative Office have been screened. In this territory the environmental friendly measures have received very low acceptance, in contrast with the experience of the rest of the Province. Just 3 farmers joined the programs for a total surface of less than 10 hectares.

2. 2 The survey

Interviews to the farmers represent one of the main chapters of the research program. At the moment more than 60 interviews have been carried out, which represent nearly two thirds of the total requested. The emerging picture is quite complex. Many aspects can be pointed out looking at this reality from different points of view.

2. 2.1 Landscape

The Roman land structure (*centuriazione*) is present in some parts of the wedge. This undoubtedly represents an element of uniqueness which justifies specific protection measures.

The *piantata*, a typical agricultural cultivation form still characterises the landscape [1]. Under the heavy influence of the mechanical innovation the piantata has become a rarity which nowadays survives in limited portions, mainly in proximity of houses, because of the care of old farmers not for the value of he production itself.

[1] The *piantata* is a straight line of vineyards between elms.

Many trees have been cut down in the recent past; but many are present, often near old retting tanks transformed into irrigation reservoirs once the hemp had lost its economic interest.

2. 2.2 Land uses

Table 1st summarises the total surface and the percentages of the observed land uses.

Water for irrigation is nowadays abundantly available, because of specific investments like the Emiliano-Romagnolo Canal.

Field crops (grains, basically wheat, sugar beet and potatoes) represent the main land use destination.

Potatoes have a suitable area for production. A high quality product, with own trade marks, represents an important source of employment and income. Two different varieties, spring and summer potatoes, permit to maximize the family employment along the year. It can be pointed out that few farmers have built their own conditioned warehouse which permits to stock and therefore to market with much better conditions.

Potatoes, vegetables and sugar beet are alternate with cereals. Wheat (*tenerum* more than *durum*), barley, corn and sorghum, are all present in the wedge. In recent years sugar beet has lost part of its profitability; agronomic reasons (root deseases) and higher production costs, not accompanied by increasing returns, are reducing the total surface cultivated. The contrary is happening to the grains because of the impressive compensation payments within the CAP. Cereals, more than proteaginous and oleaginous plants, receive the favour of the farmers. In the next section a detailed analysis of these crops will be carried out.

An important agro-industry operating in the milk sector is located in the territory, but quite surprisingly dairy farms are not very high in number and furthermore they are decreasing. In fact, the dairy sector is undergoing a concentration process although the total milk production stays unchanged. The typical integrated farms, with 10-20 cows, are disappearing while others highly specialised have entered the scene. The new mechanised dairy farms require huge investments, over 100 cows and farms large enough to produce most of the nutrients required.

Fruit does not represent a typical production of the wedge; plantations grow mainly in the northern part.

The proximity of the town justifies the presence of specialised horticultural farms mainly in the southern part of the wedge. One or more families work together and produce

for the local market fresh salad and different vegetables. These activities, which are carried out on farms of increasing size, permit an intensive use of the land, possibly under glass or plastic tunnels. The nearness to the town market makes these products most profitable, because they can be sold daily directly by the producers organised in co-operatives.

Floriculture is another form of labour intensive agriculture, which is also increasing in size and number of the farms involved. A rapid growth has invested this segment which probably is more commercial than agricultural. In fact, the most active entrepreneurs produce just a little part of what they sell and import the rest, mainly from other countries.

A peculiarity of the wedge is the existence of a experimental farm managed by the Agricultural Faculty of the University of Bologna.

2. 2.3 Rural buildings and real estate market

Rural houses are spread all over the wedge. Typical houses with red roofs, made out of bricks, two floors high can be easily found. Nearby are other buildings in the same style (stables and stores). Most of them are surrounded by well kept gardens. Often a new house, built in the ‘70s or ‘80s, rises close to the old one. In this case the former is the family home, while the latter is turned into a store. Buildings generally exceed the farm requirement but there are quite a few abandoned or decaying. This phenomenon is strictly linked to the metropolitan location of the wedge.

A peculiar segment of the real estate market deals with farm houses, which are strongly demanded by citizens who move from urban to rural areas. This allows to ex-corporate the house together with a very small acreage from the rest of the farm. The remaining land is often rented or sold to farmers who want to increase their surface, while the house looses any link with the agricultural activity.

Land market is characterised by a very low mobility and high land value. Irrigable arable land reaches 50 million Lit. per hectare and most of the transactions regard small plots which enlarge the size of existing farms.

Also rents are quite high, ranging from 900 thousand to 1 million Lit. per year and per hectare of irrigable arable land.

2. 2.4 Socio-economic aspects

Farm size, property and tenancy, family composition, as well as extra-agricultural income coming from jobs hold by other members of the family, are object of specific investigation. Even if the final results are still to come, a few considerations can be advanced.

The coexistence of many incomes in the same family is an aspect strictly related to the MAB. The decrease of agricultural labour due to the mechanisation and the extension of the working life reduced the employment opportunities in the sector. So, while the father has often kept the agricultural activity as his main occupation, sometimes the wife, quite often the sons have found external jobs. Opportunities have been easily found in other sectors, which received in the last 30 years a strong impulse mainly through a little industrialisation.

In this way, the farmer's family is a complex socio-economic unit, which can flexibly integrate the available resources. For instance: family labour can be introduced in specific periods of the year, in accordance with higher needs for agricultural operations (i.e. potatoe seeding); or, financial capital can be easily found bypassing the bank system quantity constraints and costs.

On the other side, inter-generational change has been very low. Nowadays the average farmer is nearly sixty years old, but many are older (figure 2nd).

The high cost required to buy a farm and the few opportunities to rent it, represent a strong barrier to enter the sector especially for young people. Most of the young farmers have inherited the property, and they now show higher attitude to invest in agriculture, as well as to integrate the traditional productive function with the emerging opportunities.

Agri-tourism is at the moment quite unusual, only a few farmers have started keeping horses and/or offering restoration services. The regulation existing in this field inhibits more than encourages its development.

2. 2.5 Contract farming

Contract farming is well present in this area. Many qualified contractors do all the operations requested by the agricultural activity, from plowing to harvesting.

Data on the extension of the *phenomenon* are difficult to find; many contracts are covered by different official forms. Contract-farming represents an important option for owners who cannot directly manage the farm; two different categories can be recognised: land owners who have another job and live in town and old farmers retired, without sons working on the farm. In this way owners have no constraints on their property and this represents a strong incentive to accept a lower return than the rent. This type of farm is relevant in percentage of the surface of the periurban area and is still increasing.

Many other aspects, at farm and territorial level, have been investigated but they will be object of future presentation.

3. MODELLING FARM-LEVEL

Linear programming (LP) represents a currently applied methodology to study agricultural activity at farm level. In the present case different models have been built [2] to study the main crops present in the wedge: grains, sugar beet and potatoes [3].

Representative farms have been considered taking into account the farm management [4].

A mixed integer programming (MIP) approach is requested, because the option between *general* or *simplified regime*, in accordance with the MacSharry reform, determines a binary situation: just one *regime* can be present. A second discrete variable is implied by the alternative between the *traditional* or the *environmental friendly* techniques, as visualised by the EEC regulation n. 2078/92 [5].

The models permit to quantify the present performances of the observed farms (positive approach). In a second stage we will try to foresee what could happen in a near future [6].

Introducing the following notation:

X_j = the level of the *j*th farm activity. Let *n* denote the number of possible activities, then *j* = 1 to *n*

c_j = the forecasted net return of a unit of the *j*th activity

a_{ij} = the quantity of the *i*th resource. Let *m* denote the number of resources, Then *i* = 1 to *m*

---

2 The GAMS (General Algebraic Modelling System) version 2.25 package has been applied. GAMS permits to express the optimisation problem independently of the data it uses. All data are entered in the most elemental form; requested transformations are specified concisely and algebraically in the models and their results are always available for inspection. This separation of logic and data allows for a strong reduction of the complexity of the representation and permits to increase the problem in size at any moment.

3 Two varieties of wheat (durum and tenerum), corn, barley, sorghum, sunflower, soybean, sugar beet, and two varieties of potatoes (spring and summer) represent potential crops in the models. Summer and autumn harvesting are both considered for corn and sugar-beet; the two require different agri-techniques.

4 Family farming and contract farming have been taken into account. The resource availability is completely different in the two cases. Family labour, machinery and equipment, as well as land and financial capital are all present in the family farm, just land and financial capital in the other.

5 The EEC regulation n. 2078/92 visualizes two different options: A1 and B1. A1 requires the adoption of specific measures correlated to the peculiar farm situation. Fertility of the soil, rotational schemes and other elements must be taken into account case by case. B1 requires at least a 20% decrease of the average production of the last five years through a compulsory change in the agri-techniques. For the previous characteristics only B1 permits a good model representation.

6 A decrease in the compensation payments, paid within the CAP mainly to grains, represents a probable scenario for the next future.

b_i = the amount of the *i*th resource available

the LP problem can be mathematically formulated:

$$\max Z = \sum_{j=1}^{n} c_j \, X_j$$

such that

$$\sum_{j=1}^{n} a_{ij} \, X_j \leq b_i, \qquad all \; i = 1 \; to \; m$$

and

$$X_j \geq 0, \qquad all \; j = 1 \; to \; n$$

The model elicits the optimum farm plan and estimates the main economic indicators, giving information on the structure of the costs as well as of the incomes.

3. 1 Characteristics of the models

The objective function is the maximisation of the total net return Z [7], given the resource availability and a set of restraints. It can be reached choosing the appropriate cropping system within the existing feasible options.

It can be pointed out that a deterministic approach is adopted; risk is not considered.

Production factors are endogenous into the models: each crop is entirely defined, operation after operation, in terms of input, labour and machinery requirements on an hectare basis and considering the time schedule. Resource constraints assure that the distribution of labour as well as of machinery over different crops cannot exceed the monthly availability. The possibility to hire external labour is endogenous; viceversa, the enlargement of the farm is exogenous to the model.

Different agri-techniques are considered, i.e. the shift from traditional to environmental practises determines the substitution of the tillage with a peg-tooth harrow intervention, the reduction of irrigation and low input requirements (table 2nd presents the soybean calendar in the traditional and the B1 technique).

The CAP requirements are introduced with different equations: one constraint defines the maximum level of cereal production allowed to enter in the *simplified regime*, an

[7] The enlargement of the farm represents an important decision problem for farmers,. In order to study this option, in a single-period time horizon, net return and not gross margin has to be considered.

identity defines the percentage to be left at set aside in the *general regime*; another introduces the B1 four years rotation.

Rotational schemes are the following: potatoes or sugar beet must be followed by cereals, sugar beet cannot return on the same soil for at least three years. Water supply is available and does not represent a restraint.

The operating capital must be covered by a combination of owned capital and bank capital. The latter availability is proportional to the total farm size.

Identities are introduced in order to quantify endogenously the economic indicators desired. The monthly labour use is estimated distinctly for family and for external work. Income is given by market returns to products and payments from the CAP. Fixed costs are estimated taking into account miscellaneous expenses (electricity, telephone, and other utilities), contribution for land drainage, taxes on family work, depreciation, repair, insurance of machinery and equipment and rent. Variable costs are quantified distinctly for fertilisers, seeds and other crop expenses, machinery operating costs, hired labour and services [8]. The bank capital multiplied by the interest rate quantifies the interests to be paid. Gross margin is quantified as the difference between total income and total variable costs; net return is determined subtracting from the previous the fixed costs.

The models aim to verify the presence of a positive profit. Returns to farmer's labour and capital are therefore estimated assuming that: owned financial capital can receive an interest rate of 6%; interest requirements for machinery and equipment are 5% of their average value; family work can be estimated at the opportunity cost of 10 thousand Lit./hour; management return is 1.5% of gross income; return to owned land, estimated as an opportunity cost, rises to 900 thousand Lit./hectare.

3. 2 Models of farms

3. 2.1 Family farm

The representative small family farm is of 5 hectares, 95% arable; two working units are present, while the working capital is given by two tractors (1 small and 1 medium) and all the operating equipment [9]. The family labour availability is 10 hours a day per unit, while the hired labour availability is 2 units more [10]. Farmer financial capital is 25 million Lit.

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8 Most of the external services are quantified on a hectare basis, harvesting and drying costs are determined on gross production.

9 Grain harvesting and drying are the only operations left to external services.

10 The external worker salary is estimated, including tax, at 14 thousands Lit./hour.

The optimum plan adopts the *simplified regime* and the *traditional agri-techniques.* It includes 2.38 hectares of wheat, 0.41 hectares of spring potatoes and 1.96 hectares of other potatoes. No external labour is hired and no capital is borrowed. The financial capital requested is 20.662 million Lit., while income rises to 55.365 million Lit. Net returns are over 24 million Lit. and profit is about 5.2 million Lit. See the first row in tables 3rd and 4th.

These results are consistent with the existence of such a small farm in the area. The production of potatoes permits a high utilisation of family labour (1240 hours), raising the returns. Family work available is completely utilised in July. See the first row in tables 5th and 6th for work employment.

If extra labour were available at zero cost (other family components) the optimum plan would change: spring potatoes would be pushed out by the more profitable summer potatoes, but labour would be more concentrated in few months.

3. 2.2 Enlarging the farm by rent with limited financial capital

The option of enlarging the farm renting land has been investigated [11]. The analysis explores the range between 0 and 45 rented hectares, keeping unchanged all the rest.

The possibility of fully exploiting the farm is restricted by the financial capital restraint: the owned capital is fixed and the restraint is only partially mitigated by the bank capital[12].

Doubling the surface, potatoes rise to 4.63 hectares, mainly with an increase of the spring variety which employs the family labour better.

Increasing the rented surface of the farm, potatoes slowly decrease while only wheat follows in the rotation.

A strong change comes out at 25 hectares: the optimum plan switches from the *simplified* to the *general regime*. The quantity of cereals produced exceeds now the limit fixed for the area. This compulsorily pushes the farmer to enter in the *general regime*. Set aside makes now available resources which are mainly devoted to increase spring and summer potatoes. Set aside enters from now in all the plans because the *general regime* is always adopted.

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[11] Renting land rises the financial capital requirement by 50% of the rent, plus the same percentage of the drainage costs, and a fixed value the miscellaneous expenses. At the same time the capital which can be borrowed from the bank rises of 1.5 million Lit. per hectare.

[12] The limit of 1.5 million per hectare on bank capital availability represents a real constraint, because liquidity, at the beginning abundant, becomes an increasing limiting factor.

The financial constraint calls for another change at 30 hectares of total surface shifting to the *B1 action* which requires less capital per hectare. Wheat, barley, soybean, with the same percentage come first, the remaining surface is left to set aside, potatoes and sugar beet.

Sugar beet becomes important as the total surface increases, keeping unchanged the total surface devoted to potatoes at about 6.5 hectares.

It's interesting to point out how the incidence of the support rises from 2.99% to 22.48%, with a jump in coincidence with the change of *regime*.

The total family labour does not vary greatly, rising to 2069 hours per year for 10 hectares and standing at 2639 for 50 hectares; the family labour availability is fully employed in 3 months (February, June, July). For this reason the rise of the net returns (from 24 to 78 million Lit.) pushes up the profit.

Figure 3rd represents the evolution of the cropping system; figure 4th summarises the results (on the left axis are the variable costs, the net returns and the profit in thousand of Lit.; on the right axis the hours of total labour employed).

3. 2.3 Rising the owned capital

The farmer owned capital has been changed from zero to the level requested to reach the maximum net returns, given the other resources availability.

The analysis, referred to a 10 hectare farm, shows that soft agri-techniques (*B1 action*) and *general regime* are preferred with capital scarcity; barley, soybean, sunflower cover each 2.18 hectares, the potatoes enter in a small percentage (0.87 hectare) due to their high working capital, wheat and set aside complete the plan.

Rising the financial availability sunflower, soybean and barley are pushed out and the farm becomes highly specialised in potatoes and wheat. *Simplified regime* and *traditional agri-techniques* appear as the optimum solution. Working capital goes from 15 to nearly 40 million Lit., while total income from 36 to 105 million Lit.

The incidence of CAP compensation declines from 33% to 3.14%; in the same time net returns grow from 9 to nearly 55 million Lit. In the first case profit is negative and total labour required adds up to only 544 hours, in the latter, 2298 hours of labour permit to reach a profit of 21.435 million Lit.

Figures 5th and 6th summarise the previous analysis.

3. 2.4 Contract farm

Another model takes into account contract farming. This type of agriculture is characterised by lower production (less 10%) and in general by lower returns, but for the reasons seen in section 2.2.5, many farms are managed in this way.

Adopting *traditional techniques* the optimum plan includes only wheat in *general regime*. Returns, referred to a 30 hectare farm, are about 18 million Lit., which represent less than the owner could gain renting the land.

The model shows that in the case of adoption of the *B1 action*, the optimum plan includes: wheat, barley, soybean and sunflower in the same percentage and set aside according to the *general regime*. Net returns rise to 22.346 million Lit., while the financial capital decreases by about 1/3. In this latter solution CAP support grows from 23.87% to 53.49% of total income !

4. FINAL COMMENTS

The research, still in progress, gives a first picture of the complex agricultural situation existing in the *north-eastern wedge* of the MAB.

Good soils, irrigation water availability, advanced technology, a multifold extension service, efficient commercial networks, high technical preparation of the farmers, no financial restraints are the main characteristics of the existing agriculture.

Field crops, meadows, fruit, vegetables, flowers, shifting from one to another in very close spaces, create a multicoloured landscape.

Once data collection will be ended, statistical analysis will be carried out in order to obtain an extrapolation of the sampled results to the universe.

Linear programming, with a mixed integer approach, has been applied to study representative farms, as well as to evaluate scenarios in accordance with the CAP evolution.

The higher profitability of the traditional agri-techniques explains why the EEC regulations for an environmental friendly agriculture have received very low acceptance.

The economic sustainability of the small family farm specialised in potatoes has been proved: the high gross margin and the employment of family labour permits to reach satisfying net returns.

The role of the financial capital has been investigated: low availability calls for capital extensive techniques (B1 action); its unlimited availability permits to push the agricultural process to more intensive levels and to reach the highest net returns.

In the next future *ad hoc* studies will offer more details on specific problems at territorial level, focusing on the multi-purpose role of the agriculture in the metropolitan area.

The co-operation with other experts involved in the *Pegasus Project* should permit an holistic vision of the reality and the construction of a final multi-criteria model. Such a model, taking into account the many and distinct interests involved, will hopefully be a useful instrument in the planning process to be developed looking for environmental and socio-economic sustainability.

At the same time all the efforts aim to define a research methodology which could be applied to similar situations.

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Tab. 1 Agricultural land uses observed

Tab. 1 Agricultural land uses observed

Cultivation	Hectares	%
wheat	339	*37,3*
sugar-beet	142	*15,6*
potatoes	102	*11,2*
alfalfa	83	*9,1*
fruit	44	*4,8*
corn	40	*4,4*
insiled corn	33	*3,6*
tunnel vegetable	32	*3,5*
sorghum	30	*3,3*
vegetable	24	*2,6*
sweat corn	12	*1,3*
oleaginous plants	9	*1,0*
vineyards	11	*1,2*
barley	3	*0,3*
seed	2	*0,2*
flower	2	*0,2*
asparagus	1	*0,1*
Tot.	**909**	***100,0***

Tab. 2 Machinery requirements per type of tractor and operation according to the time schedule

SOYA- BEAN						
Traditional				B1		
	CV30	CV100			CV30	CV100
PLOW.OCT		5				
HARR.FEB		1,5		HARR.FEB		1,8
TILL.APR		2,5		TILL.APR		2,5
FERT.MAR	0,5					
TILL.APR	1,5			TILL.APR	1,5	
SEED.APR	1,5			SEED.APR	1,5	
WEAD.APR	1,5			WEAD.APR	1,5	
TRAN.SEP		3		TRAN.SEP		2,7

Tab. 3 Optimum plan resulting from the enlargement of the farm with limited financial capital

REF:	TOT SUR	OWN	RENT	ARABLE	R	A	W1	BA	SO	S1	P1	P2	SA	H TOT	H FAM	H EXT
P1	5,00	5,00	0,00	4,75	2	1	2,38	-	-	-	0,41	1,96	-	1240	1240	0
P2	10,00	5,00	5,00	9,50	2	1	4,87	-	-	-	2,51	2,12	-	2226	2069	157
P3	15,00	5,00	10,00	14,25	2	1	9,81	-	-	-	2,45	2,00	-	2237	2090	147
P4	20,00	5,00	15,00	19,00	2	1	14,66	-	-	0,09	2,39	1,87	-	2244	2112	132
P5	25,00	5,00	20,00	23,75	1	1	5,25	-	11,88	-	2,50	2,41	1,71	2619	2322	296
P6	30,00	5,00	25,00	28,50	1	2	6,63	6,63	6,63	0,40	2,69	3,54	1,99	3074	2401	673
P7	35,00	5,00	30,00	33,25	1	2	7,73	7,73	7,73	1,51	2,65	3,57	2,32	3154	2460	694
P8	40,00	5,00	35,00	38,00	1	2	8,84	8,84	8,84	2,62	2,62	3,60	2,65	3234	2520	715
P9	45,00	5,00	40,00	42,75	1	2	9,94	9,94	9,94	3,74	2,58	3,62	2,98	3315	2579	735
P10	50,00	5,00	45,00	47,50	1	2	11,05	11,05	11,05	4,85	2,54	3,65	3,31	3395	2639	756

Where: R=regime (1 sim;2 gen); A=agritechnique (1=trad; 2=B1); W1=wheat (tenerum); Ba=Barley; SO=soya- bean; S1=sugar beet (type 1); P1= spring potatoes; P2=summer potatoes; SA=set aside

Tab. 4 Results of the enlargement of the farm with limited financial capital

REF:	FCR	IN	SL	SU	%SU	VC	GM	FC	NR	IF	IM	FW	MA	LA	PR
P1	20662	55365	53709	1656	*2,99*	16052	39313	15235	24078	826	4313	12401	1107	4500	5243
P2	40000	103200	99801	3399	*3,29*	34090	69110	20185	48925	1000	4313	20687	2064	4500	20674
P3	47500	116907	110070	6837	*5,85*	39465	77442	25135	52307	1000	4313	20901	2338	4500	23568
P4	55000	130585	120364	10221	*7,83*	44840	85745	30085	55660	1000	4313	21118	2612	4500	26430
P5	62500	143535	121087	22448	*15,64*	50215	93320	35035	58285	1000	4313	23221	2871	4500	26693
P6	70000	157239	128224	29015	*18,45*	55590	101649	39985	61664	1000	4313	24009	3145	4500	29009
P7	77500	171701	137850	33851	*19,71*	60965	110736	44935	65801	1000	4313	24604	3434	4500	32263
P8	85000	186163	147476	38686	*20,78*	66340	119823	49885	69938	1000	4313	25198	3723	4500	35517
P9	92500	200625	157103	43522	*21,69*	71715	128910	54835	74075	1000	4313	25792	4012	4500	38771
P10	100000	215087	166729	48358	*22,48*	77090	137997	59785	78212	1000	4313	26386	4302	4500	42024

Where: FCR=financial capital requested; IN=income; SL=sales; SU=support; VC=variable costs; GM=gross margin; FC=fixed costs; NR=net return; IF=inters on fin. owned capital; IM=interests on machinery; FW=family work; MA=management; LA=owned land; PR=profit

Tab. 5 Family work requirements (hours/year)

REF:	TOT	GEN	FEB	MAR	APR	MAJ	GIU	JUL	AUG	SEP	OCT	NOV	DIC
P1	1240	19	268	197	17	11	111	600		6	7		5
P2	2069	37	528	214	33	21	600	600		12	15		10
P3	2090	36	528	202	42	20	600	600		19	29		14
P4	2112	34	528	189	51	19	600	600		27	44		19
P5	2322	39	528	249	122	22	600	600		62	75		24
P6	2401	50	528	357	113	24	600	600	1	54	45		29
P7	2460	50	528	361	136	26	600	600	2	67	57		33
P8	2520	50	528	364	160	27	600	600	4	80	69		38
P9	2579	50	528	367	183	29	600	600	6	93	81		43
P10	2639	50	528	371	207	31	600	600	7	106	92		47

Tab. 6 External work requirements (hours/year)

REF:	TOT	GEN	FEB	MAR	APR	MAJ	GIU	JUL	AUG	SEP	OCT	NOV	DIC
P1													
P2	157		79					79					
P3	147		59					87					
P4	132		39					93					
P5	296		128					168					
P6	673		274					398					
P7	694		277					417					
P8	715		279					435					
P9	735		282					454					
P10	756		284					472					

Fig. 1 Map of the north-eastern wedge

Fig. 2 Farmers by age

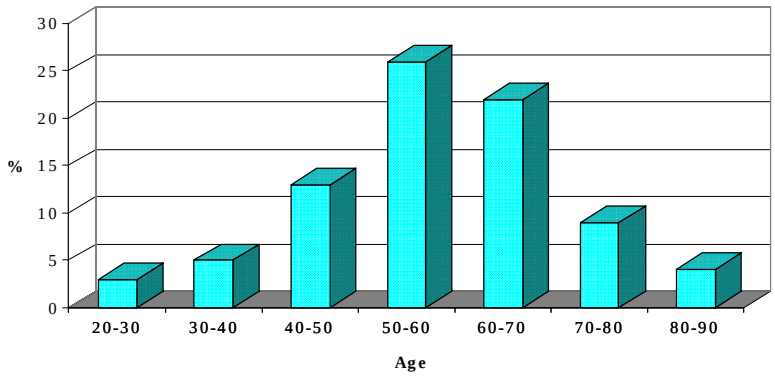

Fig. 3 Optimum plan resulting from the enlargement of the farm with limited financial capital

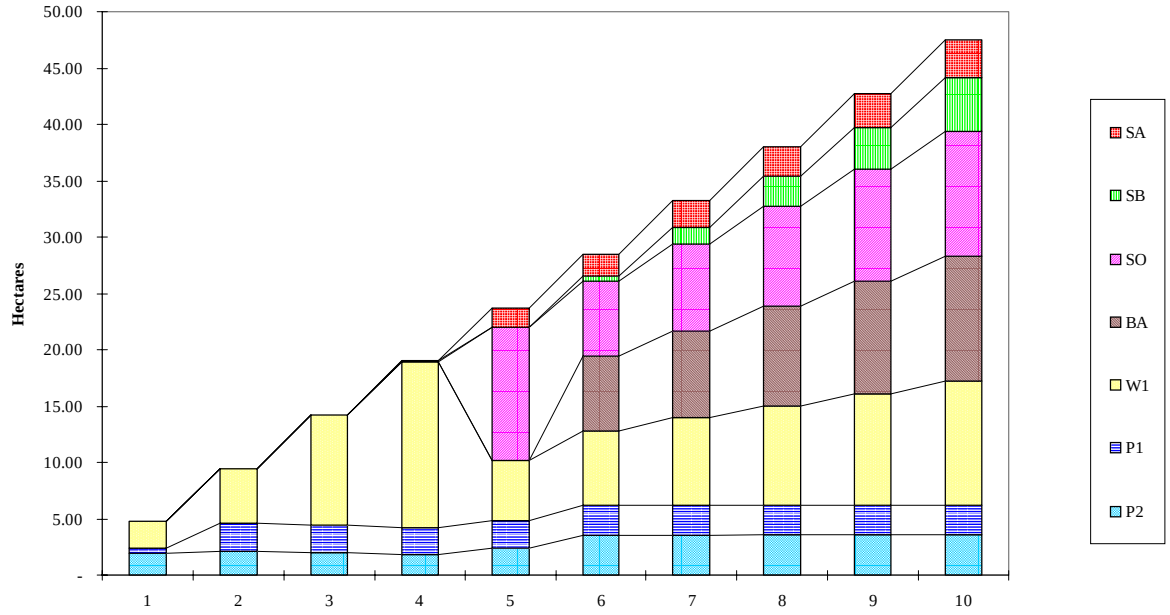

Fig. 4 Results of the enlargement of the farm with limited financial capital

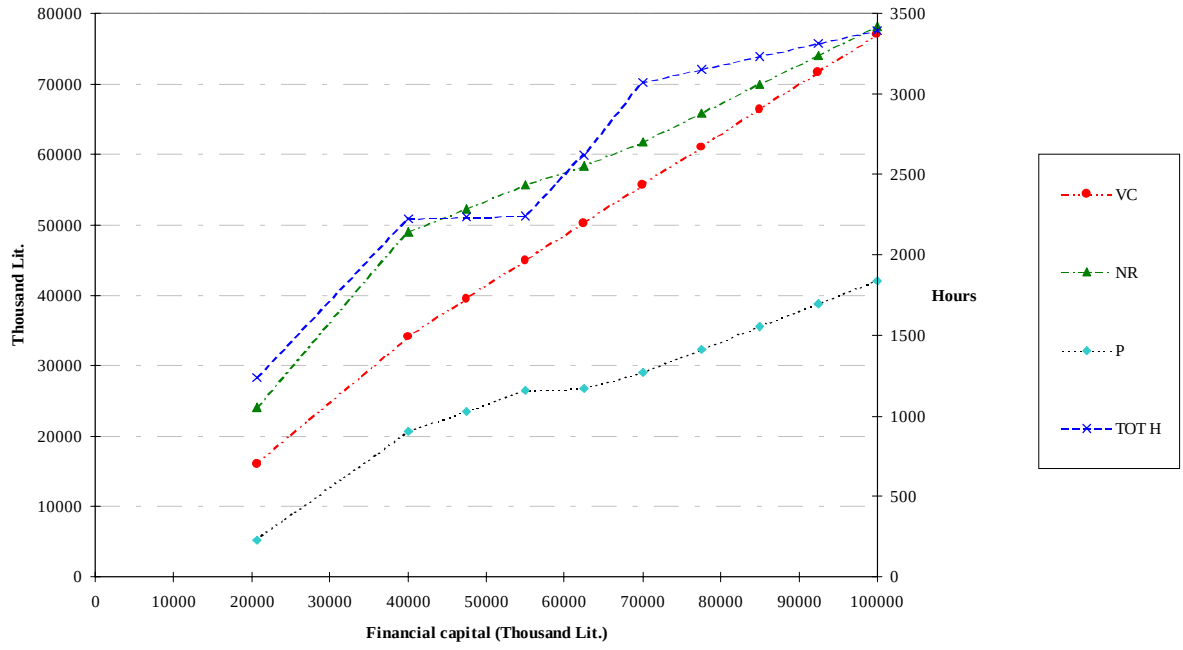

Fig. 5 10 hectares family farm: cropping systems increasing owned capital

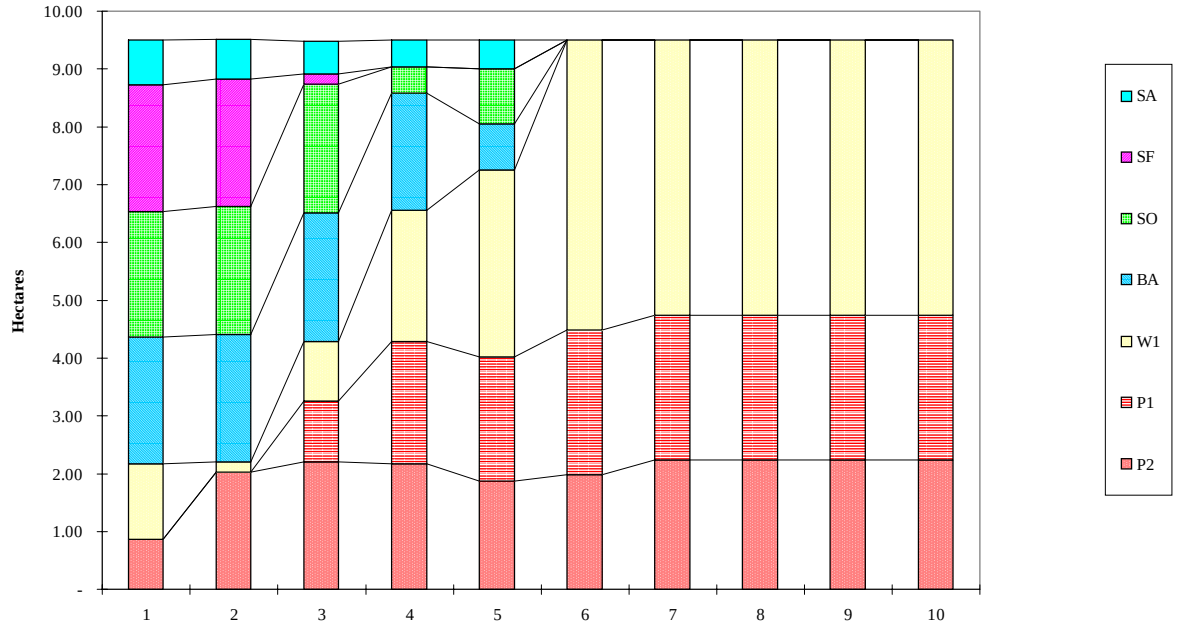

Fig. 6 10 hectares family farm: results increasing owned capital