Economic study of four agroforestry models with cocoa crop in Brazilian Amazonia

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Introduction

The implantation of cocoa program, in Amazon, was a conjugation of favorable conditions in environmental terms with the strategic guidelines of national integration of the Federal Government, implemented through special programs. The expansion of the cocoa crop for the amazon area also had other two variable of decision: ecological and socioeconomic. Ecological because the cocoa is an activity agricultural that maintain the equilibrium environmental and, therefore, adapted for the fragile ecosystems of the humid tropic. Socioeconomic, because the cocoa is included among the tropical cultures of larger economic value, could contribute to the fixation of the man on farm and to satisfy its evolution longings in the social scale, besides promoting a better equilibrium of the activity cocoa at national level, avoiding undesirable top-and-down in the production of the Country (CEPLAC, 1987).

In this study it intended to simulate through economic analysis the models agroforestry that more adapted to the system of cocoa cultivation, taking in consideration its economic, social and environmental sustainability.

Methodology

The district of Uruará, in the State of Pará, it is placed in the kilometer 180 of BR-230, denominated of Transamazon highway. It is localized in climatic types Ami and Awi, of the classification of Köppen.

It took place a survey composed of a survey of data of a sample of 50 farmers through interview with each family, where it was obtained a deeper knowledge of all the aspects that involves it: socioeconomic, agricultural, infra-structural and cultural. The instrumental basic for this process the questionnaire where was enumerated subjects that allowed to give was indicative to the agroforestry models imagined by the people involved in the research. They were also used as having given auxiliary the field results obtained by Rocha (1994), Ribeiro (1995) and Guimarães (1996) in the area of Transamazon, whose applied questionnaires contain answer to the same variables wanted in this study.

They were made the assembly of the agroforestry theoretical models, taking in consideration the areas selected cocoa crop, being made the routine economic analyses. The reasoning line was proceeded developed by Nogueira et al. (1991), that says to be important for the taking of decision regarding the implantation of perennial crop, the evaluation of the current consuming market and, mainly, of its amplification potentialities or of saturation.

To set up the models theoretical agroforestry, the orientation of Raintree (1987 p.3) was proceeded where it was taken in consideration that, " a good one draws agroflorestal needs to elevate the productivity of the system, improving certain indexes of economic efficiency such an as: the

increase of the production of the cultures, the reduction of the use of input, the increment of the efficiency of the work, the diversification of the production, among other measures. Besides, it should establish goals conservation looking for the improvement in the sustainability of the production systems, without however to forget that these should be directly related the need of increase of the farmers' income and finally, not to have as premise the perfect agroforestry design". The important is that the technology proposals are adjusted, the more than possible, to the environmental and social characteristics where it will be installed. In this sense, the participation of the farmers of the sample of this study, qualified the proposed models tends in view that the same ones discussed its indications, resulting in the attendance of the productivity approaches, sustainability and adaptability, through four models, involving as forest essences the cumaru (*Dipteryx odorata*) and the mogno (*Swietenia macrophylla*), as fruit bowls the cocoa (*Theobroma cacao*), the cupuaçu (*Theobroma grandiflorum*) and the pupunheira (*Bactris gasipaes* H.B.K.). In each one of the models it was used the available useful areas in the first year with the rice (Oriza sativa), according to the arrangements to proceed:

cumaru x cocoa x cupuaçu x pupunha x rice (I), mogno x cocoa x cupuaçu x pupunha x rice (II), cumaru x cacauE x cupuaçu x pupunha x rice (III) and mogno x cacauE x cupuaçu x pupunha x rice (IV).

The models I and II assist to the requirements of new plantations because, as it is implantation, the hybrid of cocoa crop be it sowed they will be the one of better genetic value from the nursery. The models III and IV refer to those whose cocoa crop already installed. To subsidize this alternative it made himself a rising for tramp in the properties selected by the sample, meeting that the rickety and unproductive trees represent about 80% of the plants therefore, that could be substituted. As, on the average, 900 trees/ha exists, instead of taking place the calculations with the 180 plants remainders, it opted for reducing them for 145 to be similar to the model of new plantations. Thus, the agroforestry models was with the previous same configuration of the two, just applying in the remaining cocoa the technique of the graft with hybrid selected.

For the economic analysis it was taken in consideration the fact of the proposed models they be refered to an investment alternative, the analysis was based in the financial evaluation of the investment, being the benefits and costs quantified to real prices, being presupposed that, if there is inflation, this will happen in all the sections of the economy.

The analysis horizon had as parameter the economic cycle of the cocoa, whose recommendation of CEPLAC proposes 25 years. The cost of opportunity of the used capital was of 8%, that reflects that used in investment contracts by the development banks in the State of Pará.
With relationship to the economic indicators, it was used to those available ones for the process of evaluation of projects that are second Azevedo-Filho (1996): the relationship benefit-cost (RBC), the liquid present value (VPL), the internal rate of return (TIR) and economic payback (PBE), all them, presenting advantages and disadvantages, being the liquid present value, under the point of view strictly deterministic, the most consistent with the beginnings of the economic rationality. This same author asserts that, the limitations associated to the indicators, it doesn't invalidate them as auxiliary very useful in the process of evaluation of projects, contributing in the process of taking of decisions.

Completing the methodology, the sensibility analysis was used to determine in that measured a mistake or modification of one of the variables can modify the results ends of the project. In this paper it opted for the discount rate and the costs, as the variable ones more important in the than refers to the study of its variations, looking for to identify the effects in the final result in the

calculations of the economic indicators of the model that it presented the best acting. Thus, besides the calculations made at the level of 8% for the discount rate, it was tested the modifications for 10%, 12%, 14%, 15% and 16%. In the same way, it was also tested variations in the costs in the order of 20%, 30% and 40%.

Results and Discussion

The Table 1 contains the summary of the results obtained by the economic indicators. It is clear the superiority of the model III in relation to the others and for all the indicators. Evidently, the fact of this model to count with the production anticipation, given the graft in cocoa already installed, it checks it this advantage. However, the model I should be evidenced as the most promising in the case of implantation of areas cocoa. In both models the cumaru is the differentiating of the system because its objective is the seed and not the wood as in the mogno

Table 1. Values of the indicators of decision calculated for the models agroflorestais selected in the study.

Indicator	Limits	Models			
		I	II	III	IV
RBC (un)	> 1	1,44	1,23	1,51	1,30
VPL (R$/ha)	> 0	5.277,38	2.645,53	6.193,80	3.559,98
TIR (%)	≥ 8	33	26	35	29
PBE (years)	≤ 12	5	5	5	5

Source: Mendes, 1997.

In the sensibility analysis, being used the model agroflorestal of better acting in the economic indicators, that is to say, that constituted by cumaru, grafted cocoa, cupuaçu, pupunha and rice. The results meet described in the Tables 2 and 3.

Table 2. Estimate of the economic indicators (VPL, RBC and TIR) according to the variation in the it rates of discount for the model agroflorestal of better economic acting between those studied in Uruará, Pará, 1996.

Indicators	Rate of Discount (%)					
	8	10	12	14	15	16
VPL (R$/ha)	6194,00	4133,00	3258,00	2573,00	2286,00	2030,00
RBC (un)	1,51	1,41	1,38	1,34	1,32	1,31
TIR (%)	35	21	19	16	15	14

Source: Mendes, 1998.

The values observed for each one of the indicators exhibition that, same bending the value of the discount rate, the model stays consistent occurring wide possibilities to opt for its viability as agricultural investment.

However, when the model is analyzed under the point of view of the variation in the costs, it is verified that its sensibility begins to be finer starting from superior increments at 30%. Of this point in before, when TIR passes equaling the discount rate used as indicative of viability, it is necessary care in the indication of the model agroflorestal as investment. The alternative of foreseeing

increase in the same or larger costs than 40% determine for making unfeasible the model as economic, given alternative, mainly to the low value of TIR (3%), beyond of the limit established for the study (8%). besides, RBC is very close of the unit.

Table 3. Estimate of the economic indicators (VPL, RBC and TIR) according to the variation us costs for the model agroflorestal of better acting economic between those studied in Uruará, Pará, 1996.

Indicators	Variation in the Costs (%)		
	20	30	40
VPL (R$/ha)	2895,00	1708,00	521,00
BC (un)	1,20	1,11	1,03
TIR (%)	13	8	3

Source: Mendes, 1997.

A last simulation, was constituted in comparing the results of the economic indicators of the model of better acting with those observed by the cocoa crop system in single. To arrive to the results it was used the revenue data and costs for 1,0 hectare of coca in this system, being modernized the values to the same discount rate used for the systems agroforestry (8%).

In the Table 4 it is verified that were obtained economic indicators, in the system in single, consistent, even so inferior the those obtained in the model of worse acting when in system agroforestry.

Table 4. Comparison among the results obtained in the economic indicators (VPL, TIR and RBC) for the model with better acting in the study (III) against those obtained by the traditional system of exploration of the cocoa in Amazon (single).

Indicators	Agroflorestal- Modelo III	Single Cocoa
VPL (R$)	6.193,80	2.033,64
TIR (%)	35	15
RBC (un)	1,51	1,22

SOURCE: Mendes, 1997.

Conclusion
In relation to the system plantation, the option in single is the less suitable because its contribution for the farmer's income is inferior to any one of the options evaluated in this study. The cocoa plantations in agroforestry systems, showed to be economically the most profitable.

References
AZEVEDO-FILHO, A.J.B.V. 1995. Elementos de matemática financeira e análise de projetos de investimento. Piracicaba: ESALQ-USP. Série Didática nº 109. 92p.

CEPLAC. 1987. A CEPLAC e o futuro das regiões cacaueiras : contribuição ao debate. Brasília. 142p.

GUIMARÃES, J.R.S. 1996. Padrão de ocupação e de uso da terra no município de Uruará. Belém: UFPA/NEAF. 21p. (mimeo).

MENDES, F.A.T. 1997. Sustentabilidade sócio-econômica das áreas cacaueiras na Transamazônica: uma contribuição ao desenvolvimento sustentável. 105p. Tese (Doutorado) - Universidade de São Paulo, Escola Superior de Agricultura "Luiz de Queiroz".

RAINTREE, J.B. 1987. D & D User's manual: an introduction to agroforestry diagnosis and design. Kenya: International Council for Research in Agroforestry. 105p.

RIBEIRO, S.I. 1995. Cultivos perenes. Apresentado ao 2. SEMINÁRIO SOBRE SUSTENTABILIDADE DOS ATUAIS SISTEMAS DE PRODUÇÃO AGRÁRIA DA TRANSAMAZÔNICA: A PESQUISA PARA O DESENVOLVIMENTO. Altamira. p.29-36.

ROCHA, A.C.P.N. 1994. Caracterização dos sistemas de produção da região: resultados preliminares. Apresentado ao 1. SEMINÁRIO SOBRE SUSTENTABILIDADE DOS ATUAIS SISTEMAS DE PRODUÇÃO AGRÁRIA DA TRANSAMAZÔNICA: A PESQUISA PARA O DESENVOLVIMENTO. Altamira. p.23-44.