Folder Title:	RPO Number 670-04 - Study in Multi-level Programming: Ivory Coast - Volume 2
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COMPLETED PROJECT

670-04
Study in Multi-Level Programming:
Ivory Coast Vol. II

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2) File : 670-04

OFFICE MEMORANDUM

TO: Mr. Orville F. Grimes, Jr., VPD

DATE: January 15, 1976

FROM: Brian J. Svikhart, I&PA

SUBJECT: Goreux, "Multilevel Programming Studies for the Ivory Coast" - see box

Here, for your Research Committee files, is a report from the Editorial Subcommittee's second reader. The reader has no objection to being identified to Mr. Goreux, so if you're interested I'd be happy to mention him to you by phone. Just to keep everything consistently cricket, though, we've taken the name off all printed and duplicated materials.

Let's have lunch sometime this month. I want to find out whether the Research Committee has established a muri index for their ropanis and just what else it is you do up there.

Enclosure

(12

READER #2

Sherman Robinson

Interdependence in Planning: Multi-level Programming Studies of the Ivory Coast, by L. M. Goreux.

This manuscript is very good and should certainly be an important book. It represents one of the most sophisticated and satisfying uses of linear optimizing models in any less developed country (with the possible exception of the Mexican study done at the DRC). For the purposes of planners, it is an important advance for a number of reasons. It represents a successful attempt to implement a "multi-level" planning approach which integrates a central model, sectoral models, and project analysis. It also incorporates a number of policy variables such as tariffs and taxes which are not usually included in planning models of this basic type. Their inclusion represents a major advance in the approach. The work will thus make an important contribtuion to the planning literature. The basic approach is certainly replicable in a number of countries, given data availability.

In general, I like the organization of the book; including the presentation of results before the detailed discussion of the model. However, I would very much like to see a short chapter (either at the end of Part I or at the end of Part II) giving a summary of the major empirical findings and their implications for planning in the Ivory Coast. It might be best to do it as a concluding section in chapter 6.

Chapter 1 is quite good. However, since this chapter is aimed at a non-technical audience, all references to the literature should be in footnotes, not in the text. The final section on multi-level

programming is much too brief. There needs to be an explicit discussion of decomposition algorithms and their relation to decentralized planning procedures. In this chapter, a heuristic discussion seems called for, but with adequate references to the literature. A more detailed discussion could be put in chapter 7, section 3. A general evaluation of the usefulness of the decomposition procedure should be mentioned in chapter 1 and discussed in detail in chapter 15. Or perhaps better, he could put in a final concluding chapter (chapter 18) which evaluates the usefulness of the decomposition and the multi-level planning procedures for planning in general and in the Ivory Coast in particular. I would especially like to see him compare the Ivory Coast work with the Mexico model. In general, chapter 1 should be a bit more detailed and self contained. The non-specialist ought to be able to read it and be able to follow the discussion of the results. A bit of repetition in later chapters is not bad.

In a number of different places, especially in chapters 1 and 7, he implies that the use of a non-linear utility function solves the "bang-bang" terminal year problem that plagues L.P. models. This is simply not true. Non-linear models will also have such problems, depending on how the terminal year problem is handled. In fact, the technique he proposes for handling the problem (in chapter 7) is very good and I see no particular reason why the basic approach would not also work for a standard objective function. I do not see why he could not have used discounted consumption instead of discounted utility if he had wished, and done virtually the same thing. Using discounted utility makes sense a priori since he uses the utility function that goes with the demand system he picked and it does allow him to use some extra parameters such as a parameter specifying the rate of decrease

in the marginal utility of income. In any case, I guess I am saying that I found this particular justification for his procedure not to be compelling, although I agree that it was the correct procedure and worth doing.

I have given some detailed notes on some of the chapters separately below. I will give some more general comments here. Part II is fine. My only thought is that I would like to see a grand summing up of the major empirical findings and their implications for the Ivory Coast. I personally would have liked him to pick a "basic" solution which he considered the "best" for planning purposes (which would clearly not be free-market solution). Such a basic solution would have been an easier bench-mark to look at. He gets around the problem by doing a number of pair-wise comparisons, which I found harder to follow.

Part III is, in general, very well done. I think that chapters 8 and 9 might be shortened somewhat by references to existing literature. However, there are advantages to making them self-contained. I think that a final decision might depend partly on printing costs -- they contain the most equations per page of any part of the book. The educational model in chpater 11 needs to be related to the existing literature on such models -- he has no references at all to existing models and does not compare his approach to any other work.

Part IV is the weakest part of the book. Chapter 15 is good, but I think that there is a great need to discuss decomposition and multi-level programming in much greater detail, especially considering that the title has "multi-level programming" in it. Except for an aside in chapter 1, he does not even compare this work to the Mexico study which he was involved in.

Chapters 16 and 17 are unsatisfactory as they now stand. They are both terribly written and must be redone. The problem is not merely one of style (although that is bad enough). They both contain numerous phrases which sound like technical terms but which are simply nonsense (e.g. "technique dynamisation," chapter 17, p. 7). I have gone through the two chapters and have tried to mark such confusing sentences with question marks, but more needs to be done. Also, the general presentation style is so different from the other chapters that it is jarring to the reader. I fear that the best answer would be for Goreux to rewrite the two chapters. As far as I can tell, there are no real errors -- the problem is one of presentation, not substance.

One final note. Nowhere in the manuscript is there a discussion of the data base on which the model is based. I think that such a discussion, along with an evaluation of the data, is very important and perhaps should be included as an appendix. It is clearly very important in evaluating the numerical results.

Detailed Comments on Some Chapters

Chapter 1

Pages 12-13. Using utility instead of consumption need not help with respect to terminal year problems. There are distinct kinds of problems involved which should be separated.

Page 14. Reference to the Ramsey model should be in a footnote. In general, since this chapter is aimed at a non-technical audience, all references to the literature should be in footnotes, not in the text.

There should be somewhere a detailed discussion of decomposition algorithms. In this chapter, a heuristic discussion seems called for, relating the various types of decomposition algorithms to decentralized

planning procedures. He should especially discuss the notion of multi-level planning. He should also discuss the particular decomposition procedure he used (expanding the discussion on page 21 footnote). I would also like to have seen some discussion of the problem of consistency with respect to his particular decomposition technique.

Chapter 3

Page 26. The treatment of foreigners is appropriate for the GNP accounts, as he notes in the footnote. The relevant distinction, which should be mentioned, is that between domestic product and national product. With respect to capital, he uses the GDP concept, so he is in fact mixing the two notions. The distinction ought to be discussed.

Chapter 4

Page 26. The elasticity of substitution among labor types in production is crucial to his conclusion. He notes the fact in passing (page 18 and footnote), but it ought to be discussed more. He might bring in some of the later discussion in chapter 14, pages 17-20 here. I would also like to see some discussion of the sensitivity of the shadow wage to variations in labor supply assumptions.

Chapter 5

Page 18, second paragraph. Needs to be clarified and expanded. The behavioral assumptions that drive the two versions are quite different and ought to be discussed. This is especially true considering that in the experiments he gets quite different results from the two versions.

Chapter 7

Page 7. The discussion of terminal problems needs to be clarified. He gives the impression that non-linearity solves the problem. I think that it is also not referred to correctly in chapter 1.

Even very non-linear models will have terminal year problems, as he later notes. He discusses the issues in chapter 8 when he discusses his "truncation" procedure, which I think is the best one to use. It is not just non-linearity that makes his technique the best. For example, putting the terminal capital stock into the objective function can still yield flip-flop behavior (with zero consumption in some periods) if the weight on the terminal capital stock is not correct.

Chapter 8

Pages 31-35. Very good justification for this procedure. However, it should be noted that experiments might involve changing $\bar{Y}$ (page 34) and so require iterations. However, this technique should be (and seems to be) much more robust and less sensitive than either of the two simple techniques which he discusses. Some of this discussion might be mentioned above when he discusses non-linearities in chapter 7 (as noted above). Question: How rapid (page 32) is the convergence on $\bar{Y}$?

Chapter 11

He should relate the education model to the existing literature on the subject: e.g., Bowles, Adelman, R. Stone, etc.

Page 30. The discussion of multi-level programming is not adequate. The section needs to be expanded, and/or put elsewhere.

Chapter 12

He refers to Dantzig-Wolf in a number of places (pages 2, 18). The whole question of decomposition needs to be discussed in one place in more detail.

Pages 12-16. The treatment of import substitution is quite nice. I would like to see some more discussion of the economic assumptions underlying his treatment, especially an interpretation of the Δ matrix.

In the comparison with Bruno (pages 16-17), he might compare the economic assumptions, especially with regard to the corresponding shadow prices.

Pages 21-25. There is no discussion of how much improvement or change there was in the two Dantzig-Wolf iterations.

Chapter 13

Pages 2, 31-32. If there is a premium on public revenue, it is perfectly proper to incorporate it in the analysis of tariffs. The "conflict" is an appropriate one and need not be apologized for -- only discussed. The experiment is no longer a "pure" trade experiment, but may be better and/or more realistic given that governments care about revenue.

FORM NO. 75
(7–73)

WORLD BANK GRO

ROUTING SLIP	DATE 11/6/75
NAME	ROOM NO.
~~B.B. King~~	F1233
~~Orr. G.~~	
File 0-04	

	APPROPRIATE DISPOSITION		NOTE AND RETURN
	APPROVAL		NOTE AND SEND ON
	COMMENT		PER OUR CONVERSATION
	FOR ACTION		PER YOUR REQUEST
	INFORMATION		PREPARE REPLY
	INITIAL		RECOMMENDATION
	NOTE AND FILE		SIGNATURE

REMARKS

This is an interesting review, especially as Louis Gareau tried to expound for various levels of audience. I think we may be up against the old Clemenceau cliché that military strategy is too important to be left to the generals (MM).

FROM	ROOM NO.	EXTENSION
G.W. Winterboltom	N 1002	6766

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT | INTERNATIONAL FINANCE CORPORATION

ICE MEMORANDUM

DATE: October 9, 1975

SUBJECT: Review of Interdependence in Planning

1. This text contains a great deal of interesting work and original solutions to some planning problems, however the presentation is still at a working paper stage and not ready for publication in this form. It is not "finished" either in the stylistic sense of clear, concise, and logical presentation, or in the technical sense of having completed an experiment and fully reported on the methodology and results. I am sure that these two factors interact. Even as a reader reasonably familiar with planning and programming models and with the Ivory Coast, this manuscript is not sufficiently clear for me either to develop a similar model for another country or to derive many operationally useful insights into the Ivorian economy.

2. Stylistically I like the idea of presenting a layman's explanation of the model and the most significant operational results in the beginning. In this case however I found that the lay explanation required considerably more familiarity with the literature on growth models, linear programming, and optimization than can reasonably be expected of most readers. This is particularly true of the discussion of shadow prices and the form of the maximand. The discounted value of the utility of consumption is a particularly difficult concept to apply operationally, especially when the estimate of the consumption function is at best approximate. It also leads to confusion about the value of the shadow price, which is usually expressed in terms of world prices or foreign exchange. If the results are to have any real applicability to the Ivory Coast, rather than just being illustrative, they need to be more fully explained and interpreted for the reader.

3. The technical presentation of the model was also unsatisfactory, and included some unnecessary derivations of theorems which should be familiar to the reader who would venture into this section at all. I found confusing the method of fully developing each part of the model before proceeding to the next. In each case a simplified version was presented and then allusion made to expansion to the full-blown version of that section. Some illustrative results were presented, but it was rarely clear whether these results were for the special case and depended on restrictive assumptions or for the general model, nor was it always clear what changes in assumptions and structure were requred to go from the simplified case to the general one. I often had the impression that the values of critical variables were specified rather arbitrarily when they should have been either carefully estimated from raw data or generated by the model itself. It was often not clear whether this was just for the example or built into the model. The last few chapters seemed to skirt entirely a detailed presentation of the full model in favor of some partial results, in which case they probably should have come at the beginning anyway. I have the feeling that some parts of the model were not completely worked out. Because of this and the confusing presentation, I would not feel any confidence in the stated results or in the usefulness of this methodology as it now stands.

4. The most original and interesting feature of this work is the development and application of multi-level programming to country planning, but it is very hard to grasp either the methodology or operational value of this feature from the book as it is currently written. I think a better approach to the presentation would be to carefully explain the construction and development of the whole general model in terms of highly aggregated sector model with four or five rows and columns each, rather than the hundreds of rows and columns in the current presentation. Once all of these aggregated models have been introduced and their interrelations developed, then the extension to many rows and columns in each is straightforward. Some initial experiments could also be carried out with the aggregated models to demonstrate the kinds of interactions which are possible, the model's sensitivity to certain parameters, and the limitations of such extreme aggregations, which of course are the primary justification for extensive disaggregation.

5. In terms of the book's contribution to methodology, I think the reader deserves to know how sensitive the model is to disaggregation, whether the multilevel programming technique is amenable to the mixing of highly disaggregated and highly aggregated sectoral and central models so that the model can be operational without having fully specified models for all sectors, and to what extent this technique provides additional information and insights. From an operational point of view, the reader deserves to know whether the data and analytical requirements are feasible in terms of a planning operation, under what conditions the gains in information and insight justify the additional burden of data gathering and processing, and what the limits of the model are in the current state of the art. Many of these themes are touched upon in the text, but a more organized and coherent presentations needs to be made for the book to be a valuable contribution to the literature.

670-04
Oct. 3, 1975

Reporting requirements

WORLD BANK RESEARCH PROGRAM

COMPLETION REPORT

Date of Submission: October 3, 1975

I. PROJECT IDENTIFICATION AND APPROVAL OF REPORT

Title: Study in Multi-Level Programming: Ivory Coast

Project RPO No.: 670-04

Department: Development Research Center

Division: Development Planning

Staff Members Responsible: L. Goreux

Date Approved[1]	Amount ($) Authorized[2]	Total ($) Disburse	Staff (staffmonths)
June 1971	118.4	132.6	Prof: 68 S.S. 36

Approval:

Division Chief (Signature)

Department Director (Signature)

II. PUBLICATION DETAILS, DURATION OF STUDY

Date of Contract[3]	Date of Completion[4]	Publication Date[5]
June 1971	June 1975	

Title of Final Report/Publication, Authors[6]

"Interdependence in Planning: Multilevel Programming Studies of the Ivory Coast" by L.M. Goreux with contributions by R. Vaurs and P. Davis.

Other Publications 7/

Names of Consultants/Consulting Firms/Research Institutes

NOTES:
1/ Month/year first approved by Research Committee
2/ First authorization plus supplementary authorization
3/ Date first contract signed
4/ Date final disbursement made
5/ Actual or expected publication date
6/ Indicate publication details if relevant
7/ Names of other publications linked to the project, e.g. symposium articles, journal articles, working papers, etc.

III. EVALUATION BY SUPERVISOR

The following aspects of the project must be covered in an evaluation by its principal supervisor, to be submitted as a part of this Form:

1. Quality of output in terms of its expected pay-off to intended users, both inside and outside the Bank, and the appropriate form of its distribution and dissemination.
2. The identification of further research problems that the project brings out.
3. Consistency of the output with the terms of reference to the consultants and with the approved work program of the study as a whole.
4. Implementation factors:
   - staff input, supervision and execution;
   - nature and extent of collaboration with outside research institutes, and problems encountered, if any;
   - quality of consultants.

This is an important study in its subject matter and in the methodology. As to its subject matter, the main interest of the study lies in relating project evaluation to overall planning. As to its methodology, the study presents an innovative application of dynamic optimization to the Ivory Coast. It is likely to spawn further studies using similar methods.

Considerable interest has been expressed in the study on the part of the Ivorian planning authorities, at whose request several variants of the model have been calculated. The results of the model have been used as an input in preparing the long-term plan for the Ivory Coast.

While the project deserves praise for its output, its organization left much to be desired. At the beginning, individual researchers worked on it without much supervision; one of them who has since left the Bank produced work that could not be used. This changed as Mr. Goreux was relieved from administrative responsibilities and could devote himself exclusively to the Ivory Coast study. These problems of management led the situation where only the first, or research and methodology, phase of the project was completed. The second, or application, phase was not implemented. To this extent the project cannot be regarded as "completed" as originally planned, in spite of the excellence of the first stage report.

670-04

Office Memorandum

TO : Mr. J. Duloy

DATE: September 20, 1978

FROM : L. Goreux LG

SUBJECT : Ivory Coast Working Papers

As requested by your office, I am sending you the final original copies of the DRC Working Papers on the Rural Sector Model in the Ivory Coast for permanent deposit with the World Bank:

1. Rene Vaurs, General Description of the Model System;
2. Henri Quaix and Rene Vaurs, Exports, Food Demand and Population, in English and French;
3. Rene Vaurs, North Region Model, in French;

4/5. L. Guinard, Techniques for the South Region Model and Rene Vaurs, South Region Model, in English and French; and,

6. Jacques Loup, Livestock Model, in English and French.

These papers are those referred to in the penultimate reference of the bibliography of the book, page 407.

R.P.O 204

Mr. A. Churchill, TRU October 2, 1975

B. B. King, VPD Signed B. B. King

Little-Mirrlees, etc.

This is a follow-up to my note of September 30 on Anand's Working Paper No. 213. By an odd coincidence, I came across an exposition of what is evidently the origin of Anand's statements in Louis Goreux's draft book on the Ivory Coast model (670-04). He has a sophisticated proof of a relationship which emerges, when maximizing a particular objective function, namely: discounted per capita consumption over infinite time. He also has an "intuitive" proof, which I attach in my own version without, I hope, doing violence to the original.

The first point is that the elasticity referred to is the elasticity of marginal utility (not utility) with respect to consumption (per caput in this version). I suppose that very careful reading (or prior knowledge) would have revealed this; but it is negative and he doesn't say so.

Secondly, Goreux states that econometric studies show that this elasticity ranges between -2 and -5 for developing countries. So why is 2(sic) "rather high"?

Thirdly, the full version of the relationship is as follows:

$$eg + r - n - i = 0$$

Where
e = the elasticity referred to (negative)
g = growth rate of consumption
r = marginal productivity of capital
n = population growth rate
i = pure rate of discount

Anand puts the "consumption rate of interest" equal to -eg. If that is so, it should equal (r - n - i). I suppose that with a different definition of utility (i.e. not per caput), you would leave the "n" out, leaving (r - i). But then he says "neglecting pure time preference", which seems somehow to ignore "i". That leaves the marginal productivity of capital "r". Is this what he is talking about?

My purpose is not really to enter into a debate, for which I am not that well equipped. It is to suggest that laconic statements about relatively obscure economic theory aren't good enough in a working paper. If it is meant to illuminate a critical element in project appraisal to others, at least an appendix would help. Isn't that what communication is all about?

cc: Mr. Ray

BBKing:gm

Growth, Discount and Productivity Rates

Symbols

Let C_t = Consumption

c_t = Consumption per caput

$U(c)$ = Utility of consumption per caput

$u = \frac{dU}{dc}$ = Marginal utility of consumption per caput

e = the elasticity $\frac{du}{dc} \cdot \frac{c}{u}$

g_t = rate of growth of consumption per caput (c)

n_t = rate of growth of population

r_t = marginal productivity of capital

i_t = pure rate of time discount

Objective and procedure

The objective is to obtain an equilibrium relationship between certain of the above elements, which would satisfy the following condition: that, at the margin, the utility of an increase in consumption per caput at one time, as a consequence of a shift in investment, is equal (when appropriately discounted) to the utility of the corresponding decrease in consumption at an earlier time.

We assume that an increment of investment dI is shifted forward (i.e. earlier) from time (t + dt) to time t. If investment is assumed to be permanent (i.e. does not depreciate) and has constant returns over time, then:

Decrease in consumption at time t = dI

Increase in consumption at time t + dt = dI(1 + rdt)

On the assumption made about investment, there are no other changes in consumption. In the following proof, subscripts are omitted

except where required for clarity.

Proof

Increment in per caput consumption at time (t + dt) will be:

$$\frac{dI(1 + rdt)}{(1 + ndt)} = dI\,[1 + (r - n)\,dt] \qquad (1)$$

Incremental change in utility, because of these changes in consumption per caput will be expressed by:

$$dU = \frac{dU}{dc}\,dc$$
$$= udc \qquad (2)$$

At time t incremental change in utility will thus be:

$$dU = -udI \qquad (3)$$

At time (t + dt) it will equal:

$$u_{(t + dt)}\,dI\,[1 + (r - n)\,dt] \qquad (4)$$

Now
$$u_{(t + dt)} = u\,(c_t + dt)$$
$$= u\,(c_t) + \frac{du}{dc}\,dc_t$$
$$= u\,(c_t) + \frac{du}{dc}\,cgdt$$
$$= u\,(1 + \frac{du}{dc} \cdot \frac{c}{u}\,gdt) \qquad (5)$$

Noting that the (negative) elasticity $\frac{du}{dc} \cdot \frac{c}{u} = e$,

$$u_{(t + dt)} = u(1 + egdt)$$

Hence incremental change in utility at time t + dt will from (4) equal:

$$u(1 + egdt)\,dI\,[1 + (r - n)\,dt]$$
$$= udI\,[1 + (eg + r - n)\,dt] \qquad (6)$$

We now equate the loss in utility in (3) with the gain in utility in (6) by applying the discount factor i. Cancelling out udI in each case:

$$1 = \frac{1 + (eg + r - n)\, dt}{1 + idt}$$

$$= 1 + (eg + r - n - i)\, dt$$

Hence $eg + r - n - i = 0$ (7)

This is the required relationship.

October 2, 1975

R.P.O 204

Mr. J. Duloy, DRCDR September 19, 1975

Orville F. Grimes, Jr., VPD

Completion Report for "Study in Multi-Level Programming: Ivory Coast" (670-04)

As discussed, we would appreciate receiving the attached completion report for the above project by Friday, October 10, 1975. Thank you.

Attachment
Miss Gary
cc: Mrs. Hazzah

OFGrimes:gm OG

R.P.O 204

Those listed below

September 9, 1975

Orville F. Grimes, Jr., VPD

Evaluation of Research Project

1. As discussed with Mr. Francis Colaco, a meeting will be held on Tuesday, September 30 at 3:00 p.m. in Room E723 on the evaluation of "Study in Multi-Level Programming: Ivory Coast" (Research Project No. 670-04). The meeting will be chaired by Mr. Karaosmanoglu.

2. Attached are some of the documents relevant for evaluation. They include (a) the research proposal (April 28, 1972); and (b) a summary of a technical seminar (February 27, 1973). The research output and other information on the evaluation process will be supplied by Mr. Colaco.

Attachments

Distribution:

Messrs. Karaosmanoglu, EMENA (w/o att.)
Colaco, EMENA
Gupta, Econ. Analysis & Projections
Vaurs, CPII, West Africa

cc: Messrs. Duloy
Goreux
de Azcarate/Payson/den Tuinder
B. B. King
Mrs. Hazzah

OFGrimes:gm

670-04

1. Title: Ivory Coast Programming Models (completion and follow-up)
2. Department Initiating Proposal: DRC
3. Department Responsible for the Project: DRC
4. Responsible Staff Member: A. Condos, L.M. Goreux, R. Vaurs
5. Research to be done:
   a. by Bank Staff only ☐
   b. by collaboration with a research institute ☐
   c. by consultants ☐
   d. by a combination of Bank Staff & consultants [X]

PART II PROJECT SUMMARY (attach full details as indicated in Instructions)

1. Problem to be analyzed:
Interdependence of sectors in pursuit of particular objectives, both national and sectoral (modernization of agriculture in the Savannah zone, development of a new region in the forest zone, industrial development and import substitution, "Ivorization of skilled labor, etc.). See attachment.

2. Proposed research method:

Dynamic linear programming in a multilevel planning setting.

3. Objective:
   a) Establish factual or conceptual basis for Bank policy [X]
   b) Support Bank operations in particular sectors [X]
   c) Increase knowledge of the basic development process [X]
   d) Develop institutional capacity for research in LDC's [X]

PART III COORDINATION AND APPROVAL

1. Interdepartmental Coordination:
   a. Department: West Africa , Coordinator: C. Jansen
      Comments:

   b. Department: Agriculture Projects , Coordinator: H. Adler
      Comments:

   c. Department: Economics , Coordinator: G. Purcell
      Comments: H. Thias

Initiating Department Signature: [signature] Date: April 28, 1972

3. Responsible Department Evaluation:
   a. Comments:

   b. Priority: Very High ☐ High [X] Medium ☐ Low ☐

Signature: [signature]
Date: April 28, 1972

PART IV BUDGET

1. Budget Unit to be charged: Department # 650/99 Division # _____

Item	FY 72 Amt	FY 72 $	FY 73 Amt	FY 73 $	FY __ Amt	FY __ $	TOTAL Amt	TOTAL $
2. Staff (manmonths)								
a. Professional	32		30					
b. Special Services	-		9					
Total	32		39					
3. Consultants (manmonths & $)								
a. Senior Researcher @$2500/mo*			4	10,000				
b. Researcher @ $1400/mo*								
c. Res. & Cleric. Asst.				9,000				
Total		34,000		19,000				
4. Travel (mantrips & $) 1/	1	3,000		12,000				
5. Data Processing 2/								
a. Inhouse								
b. External				25,000				
Total		20,000		25,000				

*Use this cost estimate when actual costs are not known.

1/ Use Annex I to develop travel cost estimates. Figure staff and consultants together. All travel is charged to Department's Travel Budget.

2/ Use Annex II to develop data processing cost estimates in collaboration with the Computing Activities Department.

Staff	FY 1973
Condos	10 man-months
Davis	10 man-months
Vaurs	6 man-months
Goreux	4 man-months
	30 man-months

TRAVEL COST ESTIMATES

Y	Number of Travellers	From	To	Travel* Costs	Days in Field	Expenses*	Trip Costs
72	trip a. " b. " c. Total man-trips: 3	Washington	Abidjan	5,500	90	4,500	$ $10,000
73	trip a. " b. " c. Total man-trips: 0.5	Washington	Paris Rome Abidjan	1,500	10	3,500	$ $ 2,000
	trip a. " b. " c. Total man-trips:						$ $12,000

*Refer to P&B Table of Standard Travel Pricing.

DATA PROCESSING COST ESTIMATES

(to be filled in after consultations with the Computing Activities Department)

Item	FY - Amt	FY - Cost	FY - Amt	FY - Cost	FY - Amt	FY - Cost
Inhouse						
Staff (by type) a.						
b.						
c.						
Keypunch & Verification		1,000				
In-house Computer Time						
Remote Batch Computer Time		24,000				
Time Sharing Computer Time						
Total:						
External						
Contractual Service - Staff						
Contractual Service - Computer						
Total:		25.000				
FY TOTALS						

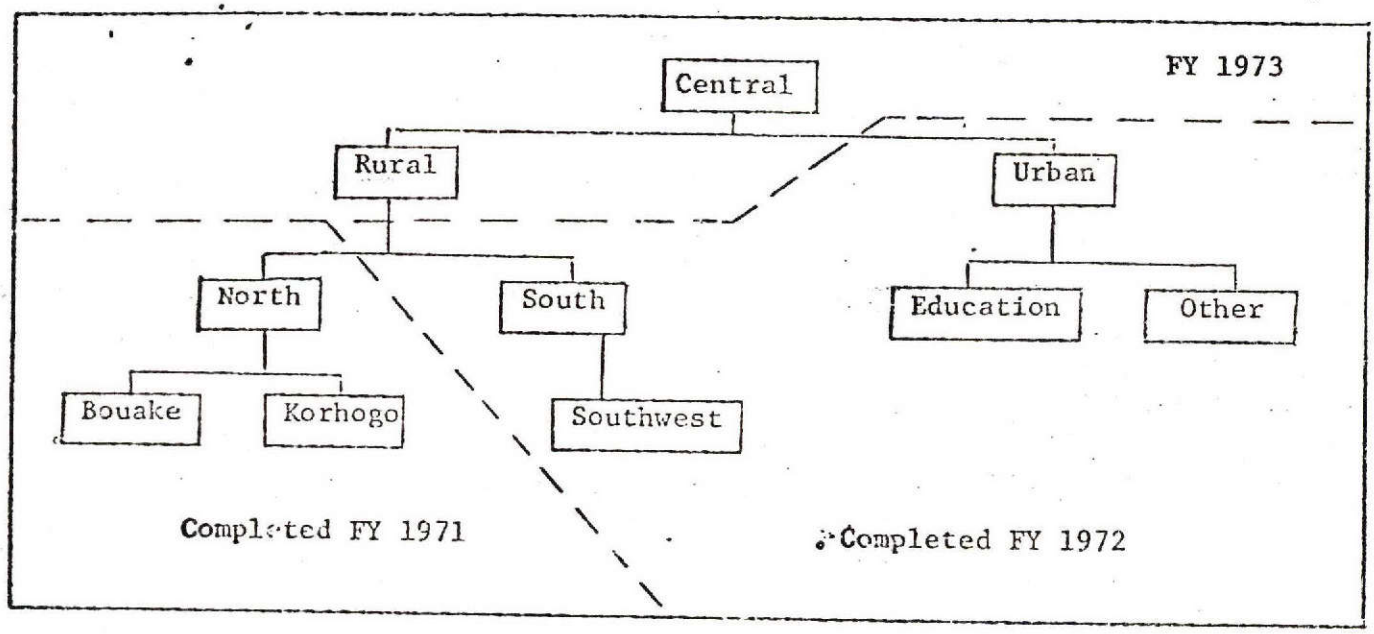
Application ID BRI

C.A. Dept. Concurrence:

STUDY ON MULTILEVEL PROGRAMMING: APPLICATION TO IVORY COAST

This is a study of the interrelations among the project, the sector and the economy as a whole. The economy is decomposed in three to four different levels, as shown in the diagram below. The Northern model was completed in FY 1971. The Southern and urban models will be completed in FY 1972. The aggregated rural model, the central model and the entire monograph are to be completed in FY 1973.

Decomposition of the Model System



1. Present State

1.1 Completed in FY 1971

The Northern model [1] analyzes the problem of agricultural development in the Savannah zone, divided between the Korhogo area (with one single rainy season) and the Bouake area (with two rainy seasons). It includes demand curves for the northern products and supply curves for labor (reflecting the labor reservation price and the cost of migrations). It permits to

study comparative advantages among traditional, improved and modern technologies. These advantages are measured in relation to the contribution of the North to national welfare and to regional income distribution.

1.2 Completed in FY 1972

The Southwest model [2] analyzes in a dynamic framework the problems of colonization in the Forest area. The main choice variables are: (a) The time-path of the investment mix among five tree crops (coffee, cocoa, coconut, palm oil and rubber) grown either in "blocs industriels" or in "plantations villagoises". (b) The time-path of the exploitation of non-reproducible forest resources and of the establishment of the associated infrastructure. (c) Producing or importing food crops.

The Southwest model allows a comparison between the project-by-project approach (several Bank projects in the area are under consideration) and a regional approach specifying the constraints common to several projects. The main common constraints are: (a) labor availability for unskilled Ivorian migrants, for unskilled non-Ivorian Africans and for skilled labor; (b) infrastructure (road, housing, clearing and planting); (c) Government budget and administrative supervision.

The construction of the Southwest model coincides with the elaboration of a "Schema Directeur" which is to define a long-term development policy for the Southwest region. The bilateral French and German aid agencies are particularly interested in this aspect of the study. One of the experts (Thenevin) participating in the formulation of the "Schema Directeur" has been working on the model in Washington.

The Southern model [3] covers the entire forest zone of the Ivory Coast and, therefore, includes the Southwest. It is broader in scope (geographical area and variety of products) than the Southwest model. But, it is more aggregated. The South provides a surplus of foreign exchange and public savings to the urban sector.

The education model [4] provides the links between the labor requirements in the economy as a whole broken down into seven skills and the supply of these skills through training and/or importation. The education model reflects the system of post-primary, vocational and formal training of the Ivory Coast which is patterned on the French system. Three alternative education "transition matrices" represent the technology of the sector (that is, promotion, repeating, dropping out rate, etc.) as it is supposed to be after planned reforms assuming moderate success on the one hand and unqualified success on the other.* Alternative solutions are obtained with different objective functions and "Ivorization" constraints.

The urban model (without education) consists of 55 sectors. The choice to produce or to import is available in 30 and export possibilities exist for 20. Technical alternatives in domestic production have not been identified, except in the case of pulp, where the output of a pulp factory could replace imports. Identification of similar projects could bring additional flexibility. The model can be used to explore broadly the issue of comparative advantage by sector and the impact of alternative commercial policies by varying parametrically the structure of tariffs and other taxes.

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*The cost elements reflected as coefficients in the technology matrices are not invariant in the historical and reform cases.

As the urban sector is the major employer of skilled labor, the previous two sub-models have been combined into a single urban cum education model enlarged urban model can be used to study a large class of development policy problems, in particular that of "Ivorization". As in the case of the rural model, unskilled labor is treated as an urban resource utilizable at the cost of a reservation price.

2. Completion of the Study (February 1973)

During his visit to the Ivory Coast (May 22 - June 30, 1972), R. Vaurs, together with Mr. Guinard (FAO/IBRD group) will review the provisional results of the Southwest and South models. He will check the data base and the policy constraints. He will also present the provisional results of the urban and education models.

During the summer, the interdependence between the Northern and Southern rural models will be studied by constructing a single aggregated rural model. It is intended to study the interdependence between the rural and the urban models in two ways. First, an approximate solution could be obtained by iterations between the central model on the one hand and the rural and urban models on the other. Second, the rural and the urban models could be aggregated and solved simultaneously.

A number of policy experiments will be conducted on individual components of the models (Southwest, education, etc.). Others will be conducted on the aggregated models. Regarding the problem of "Ivorization", it is intended to use alternatively the concepts of national, West African* and domestic welfare.

After completing the main policy experiments, some number of the research team will review the results in the Ivory Coast, probably in November 1972. The next three months will be devoted to the completion of the monograph.

3. Follow-up

3.1 Applications in the Ivory Coast

The Southwest model is expected to be used for the "Schema Directeur de l'ARSO" (Master Plan). The model system could also help in the formulation of the next Five-Year Plan (1975-1980). To accomplish this, the system may have to be expanded in the financial and fiscal area. This would require visits of some members of the DRC team.

3.2 Methodology

The system will be used to conduct experiments regarding shadow prices, capital-labor substitution and labor training. A. Condos will present a paper on the education model in May 1973 to an international conference on system analysis in Algiers. Seminars may be organized also in Abidjan, Dakar and Paris.

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* With the West African concept, when the discounted flow of consumption is maximized, non-Africans are treated as intermediate inputs. They are charged a foreign exchange cost for remittances abroad and non-competitive imports of consumption goods as well as a domestic cost for their consumption of Ivorian goods and services. For non-Ivorian Africans, only the remittances abroad are treated as costs.

Documents

[1] "An Agricultural Programming Model from the Ivory Coast Programming Study", Economic Staff Working Paper No. 125, March 1972.

In addition, a series of technical papers (in French) are available.

[2] "Ivory Coast Southwest Model", March 1972.

[3] "Description of the South Model for the Ivory Coast", February 1972.

Annexes (in French and in English):

1. Identification of rows and columns (13 p)
2. Complete set of equations (16 p)
3. Characteristics for export commodities (15 p)
4. Consumption pattern and food techniques (19 p)
5. Labor submatrix (6 p)
6. Tables for the report generator (30 p)
7. Input-output coefficients by techniques (30 p)

[4] "Urban cum Education Model", May 1972.

Annexes: Education Model, March 1972.

[5] Multilevel Planning Procedures, November 1971.

(670-04) Multi-Level Planning : Ivory Coast

This is the second of two World Bank studies which develop multi-level planning methods for use in country development programs. The results of the first study (see Ref. 670-16, page) were published as Multi-Level Planning: Case Studies in Mexico, Louis M. Goreux and Alan S. Manne (eds.) (Amsterdam and London: North Holland Publishing Company, 1973). This second study, focusing on the Ivory Coast, utilizes a set of dynamic programs to analyze policy options for the economy, incorporating linkages between projects, regions, sectors and the total economy.

Several dynamic linear programs have been constructed, for use separately and as components of a unified central program for the Ivory Coast. The component models are:

1. A northern model, centering on the problems of agricultural development in the Savannah zone;
2. A southwestern model, concerned with the problems of colonization in the forest area;
3. A southern model for the entire forest zone of the country;
4. An education model, which links labor requirements to labor supply by skill categories; and
5. An urban model, consisting of 55 sectors.

The central model is a simplified combination of these separate models and includes additional public-sector relationships. It tests the sensitivity of the key economic variables to various development paths involving different types of foreign trade policies, different configurations of regional distribution of income and

employment, and differential growth rates of overall employment. It can be solved for optimal combinations of policies subject different saving and foreign lending constraints.

The study has been conducted in close cooperation with the Government of the Ivory Coast, which has been of great assistance by providing data and by initiating further applications of the sub-models. The French agency, Fonds d'Aide et de Cooperation (FAC), and FAO have also expressed interest in extending the analysis and in some cases applying it to other countries.

Responsibility: Development Research Center - Louis M. Goreux of the International Monetary Fund in collaboration with consultants and assisted by the Food and Agriculture Organization (FAO) in data collection.

Completion date: Final report being prepared.

Reports: Condos, A., Goreux, L. M., and Vaurs, R., Agricultural Model from the Ivory Coast Programming Study. Bank Staff Working Paper No. 125. March 1972. (Catalog No. I/4.

Reference No: 670-04

INTERNATIONAL DEVELOPMENT ASSOCIATION | INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT | INTERNATIONAL FINANCE CORPORATION

Balassa file

File 670-04

OFFICE MEMORANDUM

TO: Mr. Louis M. Goreux

DATE: July 23, 1975.

FROM: Bela Balassa

SUBJECT: Ivory Coast Study

1. I find Chapter 1 very much improved in its present form. The statement of the problem, the description of the model, and the discussion of the relationship between policy objectives and shadow prices are equally clear. I also welcome the more detailed discussion of the relationship between sectoral models and the central model. Finally, the newly-added Chapter 2 provides a useful guide to the volume.

2. I have no comments to make on Chapters 10 and 11. In turn, in Chapter 12, the description of the treatment of import substitution is indeed difficult. The reader would be helped by more detailed economic interpretation of alternative formulations along the lines of our discussions a few months ago. As your modification of the method employed by Bruno is one of the principal contributions of the study, especial importance attaches to providing a clear statement of the matter.

3. Avoiding upper bounds of import substitution activities through the introduction of alternative technologies to satisfy various types of final demands represents a definite improvement over Bruno. At the same time, retaining the assumption of an upper bound for exports is difficult to defend in a country such as the Ivory Coast which enjoys free access to the huge EEC market.[1/] While making such an assumption may have been necessary for calculational reasons, its implications for the results would need to be discussed.

4. In Chapter 13, it should be noted that the equality of import prices and domestic prices will hold only for identical commodities while manufactured goods are characterized by quality differences, brand preferences, etc. In turn, the statement, "Since domestic prices are all taken as unity in the base year, the price structure of the dual solution is identical to that of the base year in that particular case" (p. 10) needs supplementing by an indication of how world prices differ between the two solutions. In other words, the question of the validation of the model would need to be dealt with.

5. I find the discussion of effective protection and domestic resource cost very clear although my familiarity with the subject matter may bias my judgment somewhat. At the same time, the unwary reader would have to be told early in the chapter what the abbreviations L.H.S. and R.H.S. stand for. Finally, a question of fact: both banana and pineapple exports to France are subject to quota and marginal revenue falls sharply once the quota is filled.

1/ On this point, see my "The Ivory Coast Study on Incentives and Comparative Advantage: Preliminary Conclusions and Policy Recommendations," to be distributed later this week.

6. I have two comments to make as regards the derivation of the free trade exchange rate. First, if you use effective rates in the formula, the supply elasticities should refer to the supply of value added rather than the supply of output. Second, the volume of non-competing imports will be sensitive to the exchange rate if higher prices of these imports, or of goods embodying them as inputs, reduce consumption. A final point: it would be useful to provide the formula for the shadow exchange rate under the assumption of optimal export taxes.

7. I also liked Chapter 14 on "Labor Employment". At the same time, it would be desirable to indicate the social profitability of employing African migrants in the way this has been done with expatriates. Our DRC calculations indicate the existence of a considerable gain in the rural sector where production is socially profitable.

8. The implications of the results for seasonal unemployment would also require further discussion. In turn, formulas (14.13) and (14.12) seem to be in error as the two terms in their numerator are the same with an inversion of the sign, giving zero as a result. Incidentally, I presume that urban wages refer to an average, taking into account wages paid in the informal sector. The problem remains, however, that for the new migrant, the probability of getting a job in the formal sector is less than for those who have been in the city for some time, not to mention those already employed in the formal sector.

cc: Messrs. Chenery
King, B.B.
Waelbroeck
Westphal
Pursell
DRC Senior Staff

File 204

OFFICE MEMORANDUM

TO: M. Louis Goreux

DATE: April 1, 1975

FROM: Bela Balassa

SUBJECT: Chapters 8 and 9 of Ivory Coast Study

Chapters 8 and 9 are worthy additions to the earlier chapters. My only comments relate to points of interpretation.

Chapter 8 provides a lucid derivation of relationships pertaining to the optimization of the consumption path. I would find it desirable, however, to include in the chapter a short discussion of parameter values used in making estimates for the Ivory Coast. While some of these are discussed elsewhere, the reader would benefit if they were considered together in this chapter.

In particular, the meaning of the interperiod elasticity of substitution in consumption and of the pure rate of time preference would need to be elucidated, and the relevance of Lluch's estimates of the substitution elasticity to the Ivory Coast discussed. Some comments are also due on the choice of values for the marginal productivity of capital.

Chapter 9 would gain from the inclusion of some of the numerical results of the formulas to the Ivory Coast. This relates to both changes in the structure of consumption of the average Ivorian and shifts among groups.

cc. Messrs. Chenery
King, BB
Rao
Waelbroeck
Westphal
Pursell
DRC Senior Staff

Mr. J. Duloy, Director, DRC January 16, 1975

Mona A. Hazzah, VPD

Research Project Status Reports, Second Quarter FY75

I would appreciate it if you could have the attached Quarterly Status Report Forms completed and sent to my office (F1233) not later than Thursday, January 30. The information provided in the forms should be current as of December 31, 1974. Listed below are the project numbers, and the name of the responsible staff member, for which Quarterly Status Reports are required.

I am attaching copy(ies) of the December External Research Computer Printout where necessary.

RPO Number	Responsible Staff Member
203	C. Lluch
204	B. Balassa
206	M. Ahluwalia
207	B. Balassa
209	M. Ahluwalia
210	B. Balassa
216	R. Norton
223	A. Stoutjesdijk
224	A. Stoutjesdijk
269	R. Norton
273	B. Balassa
283	M. Ahluwalia
284	M. Ahluwalia
285	C. Chiswick
286	J. Duloy/N. Carter/R. Norton
287	B. Balassa
294	M. Ahluwalia
308	M. Ahluwalia
309	A. Stoutjesdijk
317	P. Hazell

Attachments
cc w/att.: M. Gary

MHazzah/ls

INTERNATIONAL DEVELO NT ASSOCIATION | INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT | INTERNATIONAL FINANCE CORPORATION

204

OFFICE MEMORANDUM

TO: Mr. L. M. Goreux

DATE: November 27, 1974

FROM: Bela Balassa

SUBJECT: Ivory Coast Study

Your Ivory Coast study represents an important advance in the art of building multisectoral models. It should add luster to the DRC list of publications and would be a worthy recipient of the next Lanchester Prize.

Among the chapters distributed so far, Chapter 7 provides an excellent description of the model. My comments are concentrated on Chapters 1 to 5. I read these chapters with pleasure but also with frustration. It was a pleasure to see your ideas expressed in a clear fashion (the writing is much superior to that in the Mexico volume at a similar stage of completion). But it was also frustrating because one learns about results without adequately knowing the model structure and the assumptions underlying the analysis. My queries are expressed in the enclosed comments that were written as I progressed from one chapter to another.

For the professional economist, it would seem useful to read Chapter 7 (and, presumably, other chapters in Part II which have not yet been distributed) for fully understanding Chapters 1 to 5 of Part I. But this would defeat your purpose which I understand to be to make Part I self-contained and accessible to a wider audience. This purpose would be served by devoting a separate chapter to a description of the structure of the model and the Ivorian economy before you move to the present Chapter 2; clarifying the assumptions underlying the free market solution and relating this to the policy experiments of Chapter 5; and reviewing the entire Part I to ensure the logical progression of the argument. As regards the latter you may like to have as a guinea-pig someone who is totally unfamiliar with the model; as many other authors, you seem to assume at times that the reader knows more than what you have told him in the previous chapters.

The additional work involved in following my suggestions would be minimal compared to the work you have done on the book. I believe that it would be well worth it.

cc. Messrs. Chenery
Stern
King, B.B. ✓
Rao
Waelbroeck
Westphal
Pursell
DRC Senior Staff

Comments on Ivory Coast Study

Bela Balassa

Chapter 1

The statement "The present study served only as a background from which more imaginative scenarios were drawn by the Ivorians" (p.1) may overstate the extent to which the Ivorian government has made use of the study. I understand that it was only one of several documents that were used as background material for the Plan. In turn, the expression "imaginative scenarios" may not be an apt one. The same comment applies to the subsequent reference to "bold policy scenarios" (p.3).

I would favor starting with a short statement of what the model is supposed to do. This could then be followed by a comparison with traditional planning tools. As regards the latter, symmetry would be served by adding to the paragraph ending on page 2 the statement that "In turn, the traditional five year plan is prepared independently of project analysis". It should be noted, however, that Bruno's *Review of Economics and Statistics* paper does combine the two.

It should further be pointed out that while project analysis relates to the allocation of new investments, the model also permits changes in factor proportions for existing facilities. For the sake of symmetry with the discussion of what the project analyst can do with the model (pp.2-3), one may state the choices available to the firm manager. The policy tools employed in the model should be described next while the repetitive statement on material balances should be deleted.

In discussing the conception of the model, reference should be made to differences in the private and the public evaluation of the choice between present and future consumption and the distribution of consumption. The statement on page 4 would seem to imply that private choices determine the outcome. Income distributional considerations should also be introduced in regard to the Pareto optimum (p.6) as these would necessitate lump sum transfers if efficiency

losses are to be avoided. Such transfers are, however, not practicable so that "soaking the rich" (p.9) will also reduce efficiency. More generally, the question is if the model "shadow prices" the cost of raising taxes.

The statement "The model operates on the basis of a system of efficiency prices, called shadow prices" (p.6) also requires further discussion. Private firms, who dominate in industry as well as in agriculture, act on the basis of market rather than shadow prices. This seems to be recognized in the statement that "the appropriate incentives have to be provided" (p.9) to the private sector. But it is not made clear how it would be ensured that entrepreneurs undertake the "right" projects and use the "right" factor combinations, when the shadow and the market prices of primary factors and foreign exchange may differ to a considerable extent. In particular, while the selection of projects may be guided by appropriate incentives, the choice of optimal factor combinations in implementing projects as well as in existing establishments would require the use of a complicated tax-subsidy scheme to equate market prices to shadow prices.

In the discussion of the solution of the model, there seems to be a conflict between the statements that the model was solved with three different values of pure time preference (pp.7-8) and that the pure time preference is derived from the choice among alternative time paths (p.8). Also, the criteria of choice should be briefly indicated and the relevant footnote clarified. Finally, the comparison with the Mexico model could usefully proceed beyond the first two steps (p.14) and the choice of a "deterministic" model for education (p.14) would need to be clarified (*ibid*).

Chapter 2

The choice of the educational pattern (p.3) would also need to be clarified as the replacement of university-trained expatriates by Ivorians would not necessitate the stagnation of new enrollment in high school during the 1975-80

period if upgrading the labor force brings sufficiently high returns through increases in productivity. Indeed, the share of skilled labor among nationals in 1990 (13 percent) is still rather low (p.4). This may be explained by a lack of sufficient flexibility in the model to handle skill-substitution or by the assumption that "promotion to the highest skill category is gained through experience and does not require any formal training" (Ch.3, p.1).

Also, it is not clear in this chapter if the replacement of expatriates is a policy objective *per se* or whether it is a result derived from the model itself. The statement about "the need to replace expatriates by nationals for increasing the profitability of import-substituting industries" (p.10) points to the first interpretation while statements made elsewhere in the chapter support the second. At the same time, it is doubtful that "heavy borrowings from abroad" (p.21) can proceed *pari passu* with the replacement of expatriates as the two are in part complimentary.

More generally, the policy assumptions made in this chapter would need to be spelled out. It should be stated which policies are considered as given and thus constrain the solution and which can be manipulated to maximize aggregate growth that is the stated objective (p.1). From a later passage (p.21) it would seem that the model does not include infant industry tariffs and export taxes for the purpose of exploiting the Ivory Coast's monopoly position in certain products. If so, the "free market solution" would refer to free trade and it will not be optimal unless the Ivory Coast is price taker in all of its export markets.

Implicit (p.21) and explicit (p.26) export taxes are said to be used, however, to capture the rent element in exports. This is understandable in the case of forestry (p.26) although I wonder if the rent element could not be taxed directly. Also, I question the use of (implicit) export taxes in industrial exports (p.21).

There is justification for such a measure only if foreign demand is less than infinitely elastic. And, in this case, optimal export taxes would need to be used. Similar considerations apply to coffee and cocoa where the export price is a function of the amount exported by the Ivory Coast.

Further questions arise concerning possible differences between market and shadow prices of labor. If there is excess supply of unskilled rural labor, optimality would require subsidizing labor use. Differences between market wages in 1970 and efficiency wages during the period covered by the model are of further interest. It would be useful therefore if Table 2.2.E included data for 1970.

The latter comment also applies to Table 2.2.G on total returns to labor and capital. As regards the share of capital, you state that its increase between 1975 and 1985 is explained by the increase in foreign capital inflow (p.23). One should also consider, however, that the replacement of expatriates will increase the share of labor since foreign exchange expenditures for expatriates are replaced by (high) salaries paid to domestic nationals.

Finally, it is not clear how the statement that "In the free-market case, the volume of savings is optimized" (p.28) relates to the objective of maximizing growth (p.1) and how optimization is achieved. Presumably, raising the share of investment to 25-30 percent of GNP requires interference with private choices between present and future consumption, so that the expression "free-market solution" may not be appropriate. It also requires huge public investments, a substantial part of which would be physical investment, where the share of the private sector is shown to be only 30-40 percent. The implications of this change, including the establishment of state enterprises, would require discussion.

Chapter 3

This chapter elucidates some of the issues raised in connection with Chapter 2. Still, I am not convinced about the need for reducing the rate of growth of high school enrollment to the extent shown in the model. The question of skill substitution is raised on page 19 but references to international comparisons with a few developed and African countries do not provide a satisfactory answer. In particular, data for Korea and Taiwan would give a very different picture. The projected increase in the ratio of the wages of skilled to unskilled labor from 100 in 1975 to 136 in 1985 (Table 3.7) also points to the need for increasing high school enrollments above the level indicated in the model.

Further questions arise as regards the replacement of expatriates by domestic nationals. On page 8, it is noted that "full Ivorization is reached by 1990 without imposing any constraint regarding the time at which Ivorization should be completed". It is further added that replacing expatriates is a socially profitable activity as "In 1980, the shadow price of the average expatriate is 34 times as high as that of the unskilled urban worker" (p.8). In fact, this ratio continues to rise during the period under consideration, reaching 37 in 1985 (Table 2.2.E). Now, as the marginal source of supply of professional labor consists of expatriates (p.8), nationals of equal productivity will receive the same salary and, with productivity differences falling over time, the incomes of nationals would increase even faster. Apart from its social consequences referred to on page 29, this result conflicts with the experience of other countries except Brazil where real wages of unskilled labor were held down by government action.

The result hinges on the assumption that expatriates provide the marginal source of supply of professional labor and hence determine its price. This may

indeed be the case as long as expatriates provide a large proportion of professional labor. However, with their continuous replacement, they will increasingly be confined to the higher echelons and their cost becomes irrelevant to the lower echelons of professional labor. At the same time, the decline in wages of professional labor would be accelerated if new enrollments in university and higher education continued to increase after 1985 rather than stagnating as assumed in the model.

Chapter 4

The analysis of the domestic resource cost of foreign exchange (DRC) may be usefully reformulated in terms of a composite unit of domestic resource (p.3). This would permit relating the DRC measure to the contributions of Bruno and others. At the same time, note should be taken of the lack of realism of the assumption of unchanged relative prices of factors which underlies the application of this measure.

The meaning of effective protection should be explained in terms of the net effects of tariffs on inputs and outputs of a productive activity (p.6). It should be added that effective protection will be higher than the tariff on the output only if the latter exceeds the average of input tariffs. Thus, the statement that the effective tariff "is, on the average, substantially higher" (p.6) than the nominal tariff does not have universal applicability although it may apply in the Ivory Coast.

Further questions arise regarding the definition of the shadow price of foreign exchange. On page 6 this is taken to be equivalent to its market price. While this will be the case in the absence of tariffs, the shadow and the market price of foreign exchange will diverge in the event that tariffs are introduced as these will create a wedge between the demand price and the supply price

of imports. The shadow price of foreign exchange can then be defined in first-best and second-best terms; since it is to be used for project evaluation in the framework of the model, I presume that the latter will be appropriate. Applying the Harberger-Schydlowsky analysis, the shadow price of foreign exchange can be shown to exceed the market price. The same result is reached if a first-best concept is applied.

In analyzing alternative time-paths of consumption and savings (p.11), consideration would need to be given to changes after 1990 since much of the fruits of a higher rate of savings will be enjoyed only then. In turn, foreign capital is properly regarded as a substitute for domestic savings, when account needs to be taken of its elasticity of supply. If the supply of foreign capital is infinitely elastic, its cost will be the opportunity cost of capital to the economy just as the salary of expatriates was the opportunity cost of labor. Accordingly, investments would be undertaken that earn at least as much as the rate of interest on foreign capital. At the same time, attention would need to be given to existing differences in regard to the supply of portfolio and direct investment. On this, see Garry Pursell's paper on estimating the shadow prices of capital in the Ivory Coast.

These considerations suggest the need for a modification in the definition of the shadow price of foreign capital by introducing supply considerations. At any rate, the discussion of the relationship between the shadow price of foreign capital, foreign exchange, and savings (p.11) should be clarified. The meaning of own rates of interest on foreign capital (p.23) would also need clarification.

Chapter 5

References are made in this chapter to disguised urban unemployment (pp.3,4) and unemployment (p.5) under the free market solution. However, the magnitude of unemployment is not indicated in Chapters 2 and 3 that provide

information on labor markets. Nor is it clear what is meant by full employment and recession years. These issues should be discussed together with possible differences between market and shadow wages referred to in my comments on Chapter 2. Related questions are the appropriate choice of the welfare function in evaluating immigration from the neighbouring countries.

The understanding of the North experiment (p.6) would be enhanced if the relative importance of this region in the Ivorian economy were indicated. Note further how the minimum production targets were arrived at and whether increased employment in the North means less out-migration, more inward-migration or less unemployment. The interpretation of the results will differ to a considerable extent in these cases.

Uniformity of treatment would be ensured if the various policy scenarios were related to the "free market experiment". In the present version of the chapter, the point of reference is existing tariff levels in Table 5.7.A, free trade in Annex Table V.1, and Scenario 2 presumably reflecting an in-between situation in Table 5.10.B. Also, the policy assumptions underlying the free market experiment should be clarified.

The effects of removing protection on employment appear beneficial in both the rural and the urban sector. As it is customarily assumed that eliminating tariffs would reduce rather than increase urban employment, the results would require further discussion. In this connection, it would be helpful to indicate changes in productivity and employment in particular manufacturing sectors.

Chapter 7

This is an excellent description of the basic structure of the model. Among the underlying assumptions, my only queries relate to the elasticity of

intratemporal and the intertemporal substitution and to increases in income per head in urban and in rural areas. The postulated equality of the elasticity of intratemporal and intertemporal substitution (p.3) will hold only under restrictive assumptions which may not be fulfilled in the real world; hence, it would be desirable to indicate the implications of the nonfulfilment of this condition. Also, the implications for the results of the assumed equality of per capita income growth rates for urban and for rural populations in the projection model (p.11) would need explanation.

As regards the interrelationship between the central model and the sectoral models (p.24), the reader would benefit from a more detailed discussion of the latter. This could be accomplished by inserting a new chapter in Part I as suggested in the covering memo. The supply price of unskilled labor (pp.26-28) would also require further discussion. And, finally, Figure 7.3 may confuse rather than elucidate "the overall picture".

Finally, the discussion of conflicting goals among government agencies is interesting, but clarification is needed on the policy assumptions made and on the implications of conflicting goals for the solution of the model. Thus, while references are made to differences in the evaluation of tariff structure in investment appraisal and in commercial policy, it is not explained what these evaluations are. Alternative targets as regards taxes would also need further explanation. It would seem useful to devote an entire section to these issues rather than a page or two.

R.S M2
-4 O.P. Research
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July 11, 1974

Letter No. 223

Mr. Hans Wyss
Chief, World Bank Permanent
Mission in Western Africa
P.O. Box 1850
Abidjan, Ivory Coast

Dear Hans:

I returned to the Bank about a month ago as Research Adviser, which means that I have something to do with the Bank's research program. For that reason, I shall be coming to the conference organized by OECD in Abidjan on August 9 and 10. Andy Kamarck is coming too, as you may know.

I expect to arrive in Abidjan on the evening of the 8th. At present I intend to go on to Nairobi on Sunday the 11th (about 2:00 p.m.), unless you think there is virtue in my staying longer. This would be the case if you thought (a) it was worthwhile talking to anyone in the Government (assuming they are not caught up in the S.I.D. meeting the following week) about the two Bank research projects in the Ivory Coast (204 and 287, see enclosure), or (b) you or your colleagues have any ideas on economic research that we would not have time to talk about otherwise. I believe the next convenient (or not so inconvenient) connection is on Tuesday.

I would much appreciate it if you could cable your advice.

Sincerely yours,

Benjamin B. King
Research Adviser
Development Policy

Encl.

BBKing:gm

Multi-Level Planning: Case Studies in Ivory Coast

This is one of two case studies whose purpose is to develop and apply multi-level planning methods to country development programs. The first to be completed was published as *Multi-Level Planning: Case Studies in Mexico,* Louis M. Goreux and Alan S. Manne (eds.) (Amsterdam and London: North-Holland Publishing Company, 1973) (*see* RPO 216, page 30). The Ivory Coast study employs a set of dynamic programs to analyze policy options for the economy, incorporating linkages between projects, sectors and the total economy, as well as between regions, and between rural and urban areas.

Several dynamic linear programs have been constructed, for use both separately and as components of a unified central program for the Ivory Coast. The component models are:

1. Northern model, covering the problems of agricultural development in the Savannah zone.
2. Southwestern model, covering the problems of colonization in the forest area.
3. Southern model, covering the entire forest zone of the country.
4. Education model, linking labor requirements to supply by skill categories.
5. Urban model, consisting of 55 sectors.

The central model is a simplified combination of these separate models and includes additional public-sector relationships. The model can be solved for optimal combinations of policies subject to alternative saving and foreign lending constraints.

This comprehensive study addresses many of the critical issues of planning and economic decision making in the Ivory Coast. The individual models cover such problems as optimal investment planning in the large forest area in the Southwestern region where individual projects compete for common resources such as land, labor in peak periods and infrastructure; the effect of alternative educational policies (formal versus nonformal training) on the replacement of expatriate professionals and managers, and on the employment prospects of the newly educated; the scope for improving technology in the Savannah, and its relation to farm incomes, rural employment and the government budget.

The central model tests the sensitivity of the key economic variables to alternative development paths involving different types of foreign trade policies, different configurations of regional distribution of income and employment, and differential growth rates of overall employment.

The study has been conducted in close cooperation with the Government of the Ivory Coast, which has been of great assistance by providing data and by initiating further applications of the submodels. The French agency, Fonds d'Aide et de Coopération (FAC), and the Food and Agriculture Organization (FAO) have also expressed interest in extending the analysis, and in some cases applying it to other countries.

Responsibility: Development Research Center—Louis M. Goreux, in collaboration with consultants and assistance by FAO in data collection. (Ref. No. RPO 204)

Completion date: December 1974.

Reports

Condos, Apostolos, Goreux, Louis M., and Vaurs, R. *Agricultural Model from the Ivory Coast Programming Study.* Bank Staff Working Paper No. 125. March 1972. (Catalog No. I/4)

INTERNATIONAL DEVELOPMENT ASSOCIATION | INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT | INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

671.04

TO: Mr. D. C. Rao

DATE: May 14, 1974

FROM: Anandarup Ray

SUBJECT: Panel Reports on NE Brazil Regional Studies, and Rural Saving and Investment

1. The panel, consisting of Messrs. Baneth (Chairman), Greene, Krishna and myself, met on May 10 to discuss these proposals with the sponsors. We are writing to you separately on "Foodgrain Production in Asia".

NE Brazil

2. The first phase (the survey work plus preliminary theoretical work), appears to be progressing well. The necessary institutional cooperation has been successfully established, contrary to some of the earlier doubts.

3. The proposed work program for the second phase is in line with that anticipated earlier. The only question is whether all of it (particularly item D) can be fully accomplished within FY75.

4. The panel recommends continuation of this study, as proposed, subject to a budgetary review which it did not undertake.

III.3 Rural Savings

5. This proposal should be viewed largely as a research preparation project. The panel regards the subject matter to be of high priority, and is satisfied that the need for the preparatory work exists. It recommends that the survey part of this proposal be accepted. The proposed field testing of the questionnaire should be reconsidered later in the context of the full field survey that may be undertaken. Without the latter, the field testing will not be very useful.

Cleared (in substance) with Mr. Baneth
Cleared with and cc: Messrs. Greene, Krishna
cc: Messrs. Duloy, Gulhati, Clark, Yenal, Acharya and Mrs. Hughes

ARay/jb/mm

INTERNATIONAL DEVELOPMENT ASSOCIATION | INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT | INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

WHITE

TO: Mr. Jorge Cauas, Director, DRC DATE: April 8, 1974

FROM: D. C. Rao

SUBJECT: Development Strategies in Semi-Industrial Countries (RPO-201)
- and -
Ivory Coast Programming Models (RPO-204)

1. Although there has been no expenditure from the Research Budget on these projects in FY74, I understand the work has not yet been completed. Could you please arrange to include a brief status report on the above projects in the quarterly submission that is due by April 15.

2. Please continue to submit Quarterly Status Reports until you are able to submit a Completion Report.

cc: Mr. Ernest Stern
Miss Myrna L. Gary
Mrs. Mona Hazzah

DCRao/wg

INTERNATIONAL DEVELOPMENT ASSOCIATION | INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT | INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

TO: Listed below

DATE: June 7, 1973

FROM: Jorge Cauas

SUBJECT: Ivory Coast Review Committee
Friday, June 8, 4:30 p.m. - DRC Conference Room

attending? NO

The Review Committee follows the session of the Technical Committee held on February 14, 1973 and precedes Mr. Goreux's visit to Abidjan june 11 through 22.

The list of documents is:	Pages
1. Policy Experiments	15
Annex	5
2. Description of the Central Model	26
Annex: Algebraic Formulation	25
3. Education	12
Annex	50
4. Reduced Form	13
Annex: D Matrix	60

The first technical meeting was held on documents (3) (Lethem's report attached); the second was held on document (4) (Tims, Chairman).

The first document is attached. The other documents, which have already been distributed, are available on request.

Please note that the time of the meeting has been changed from 11:30 to 4:40 p.m., because of Mr. Arthur Tiemann's funeral.

Distribution:

Messrs. Chenery
Stern
Jansen
de Vries
Tims
Baneth
Balassa
Duloy
Clark
Ahluwalia
Goreux
Vaurs

LGoreux/msg

POLICY EXPERIMENTS

This paper is divided into two sections. The first one describes the evolution of the Ivory Coast economy in the context of a resolutely outward-looking policy. Maximum advantage is taken from the international exchange of goods, capital and labor. As shown in table I-A, the economy grows at approximately six-and-a-half percent a year. The number of foreigners increases in the seventies. But, due to the vigorous expansion of the educational system, expatriates are not needed any more in the second part of the eighties.

The key feature is the importance taken by the new educated elite. As wages remain high until the mid-eighties, the wage income accruing to this class rises from 6.5% of the GNP in 1975 to 17% in 1985. This elite, who is the main beneficiary of economic growth, has to contribute to the expansion of domestic savings. Only in this way can "l'ivoirisation des cadres" be followed by "l'ivoirisation des capitaux".

After having reviewed the basic scenario in the first section, we move to five other possible scenarios in the second section. As shown in table II, each time a move is made from one scenario to the next, policies become less outward-looking and more nationalistic. Since the changes are cumulative, we end quite far from the free entry of goods, capital and labor.

Policy changes do not affect only the relations with the out-

side, they also affect the balance between regions. Thus, in scenarios five and six, the government makes a strong effort to develop agriculture in the north. Due to this effort, by the year 1990, the number of agricultural workers in the north is more than twice as large as it would have been otherwise.

I. The Basic Scenario

The very high wage structure for high-skill labor today is a serious handicap for industrialization. Among the professionals employed in manufacturing, expatriates are still the majority. On the one hand, with the expatriation premium, the cost of a French engineer is at least 50% higher in Abidjan than in Paris. On the other, there is a growing surplus of unskilled urban workers; many among the younger ones have a primary education training. Under these conditions, it is not surprising that post-primary education appears, in the model, as the most profitable import-substitution activity. The optimal solu-

Table 1: Outward Looking Policy

1A. Economic Aggregates

	Absolute Levels					Growth Rates				
	1970	1975	1980	1985	1990	70-75	75-80	80-85	85-90	70-90
	(10^9 FCFA)					(percent p.a.)				
(1) GNP	367	518	718	993	1315	7.1	6.8	6.7	5.8	6.6
(2) Consumption	233	332	442	623	818	7.3	5.9	7.1	5.6	5
(3) Material investment	78	94	131	188	257	3.8	6.9	7.5	6.5	6.1
(4) Human investment	12	29	56	56	65	19.3	14.1	-	3.1	8.8
(5) Total investment[1/]	90	123	187	244	322	6.5	8.7	5.5	5.7	6.6
(6) Private savings	34	46	75	125	213	6.2	10.3	10.8	11.2	9.6
(7) Govt. savings	50	60	90	125	160	3.7	8.5	6.8	5.1	6.0
(7) Net capital inflow	6	16	21	-5	-50	21.7	5.6			
(9) Govt. revenue[2/]	115	155	222	317	423	6.2	7.5	7.4	5.9	6.7
(10) Govt. expenditures	75	110	163	222	298	8.0	8.2	6.4	6.1	7.1
(11) Commodity exports (FOB)	125	144	213	289	406	2.9	8.1	6.3	7.0	6.1
(12) Commodity imports (CIF)	108	126	192	263	347	3.1	8.8	6.5	5.7	6.0
(13) Wage bill of foreign skilled labor	68	77	98	34	-					

[1/] (3) + (4) = (5) = (6) + (7) + (8)

[2/] Net of capital inflow

Table I-B: Education Statistics

	Absolute Levels					Growth Rates				
	70	75	80	85	90	70-75	75-80	80-85	85-90	70-90
	(10^6 persons)					(percent p.a.)				
New enrollment in the first year of secondary	10.7	18.5	20.9	21.3	31.0	11.6	2.5	0.4	7.8	5.5
Student population:										
Technical	3.1	7.5	15.7	16.6	18.8	19.3	15.9	1.1	2.5	9.4
Secondary	37.3	68.0	104.7	116.0	145.6	12.8	9.0	2.1	4.7	7.1
University	1.5	3.4	5.7	6.4	7.4	17.8	10.9	2.3	3.0	8.3
Imported skilled labor:	17.3	21.0	37.2	14.3	0	3.9	12.1	-17.4	-41.2	-13.3
Skill 2	--	--	2.9	--	--					
Skill 3	--	.6	3.1	--	--					
Skill 4	--	1.2	--	--	--					
Skill 5	5.0	5.8	17.8	12.9	--					
Skill 6	5.4	5.5	5.6	--	--					
Skill 7	4.9	5.7	7.8	1.4	--					
Skill 8	2.0	2.2	--	--	--					
	(10^9 F.C.F.A.)									
Wage bill of foreign skilled labor	67.8	77.0	98.4	34.2	--	2.6	5.1	-19.4	-50.0	-19.0
Human investment in education	12.0	29.3	56.0	56.4	65.2	19.5	13.8	--	3.0	8.8
Current govt. expenditures on education	12.0	17.4	31.5	31.4	37.7	7.7	12.6	--	3.7	5.9
	Ratio									
Human investment/ Total investment	13.3	23.8	29.9	23.0	20.2					
Education expenditures/ Total expenditures	16.0	15.8	19.3	14.0	12.6					

tion is the big educational push, right from the beginning. The problem with the big push is to check the growth of new enrollments long before "ivorization" is completed. Otherwise, the market becomes flooded with graduates a decade later.

Because the model optimizes the enrollment path simultaneously throughout the planning horizon, no unwanted graduates are produced. But, in the absence of constraints on the school population in 1975, flooding is avoided in 1985 and 1990 by closing the schools in 1980.

Consider the basic solution presented in table I-B. The student population increases very rapidly between 1970 and 1980, but very slowly between 1980 and 1985. Nevertheless, schools need not be closed in 1980, because two constraints are imposed. First, the student population cannot decline. Second, there is an upper limit to the size of the school population in 1975. The effect of removing the second constraint is illustrated in table I-C. Suppressing this constraint increases new enrollments in secondary schools by 6.6 thousand in 1975 and reduces it by 7.5 thousand in 1980. As a result, without constraint, new enrollments are cut by almost half within five years, from 25.1 thousand in 1975 to 13.4 thousand in 1980. Note that the cut required not to flood the market in 1985 and 1990 takes place precisely when the number of foreigners is at its peak (wage bill of 94 billion FCFA). Politically, this may not be an easy thing to achieve.

Table I-C: Effect of removing the constraint on the size of the student population in 1975.

	1975	1980	1985	1990
New enrollment in "sixième"				
(1) Constraint (table I-B)	18.5	20.4	21.3	31.0
(2) No constraint	25.1	13.4	24.7	30.2
(3) = (2) - (1) = Difference	+ 6.6	- 7.5	+ 3.4	- .8
Number of students in "secondary"				
(1) Constraint	68	104.7	116.0	145.6
(2) No constraint	83.9	103.7	109.8	141.8
(3) = (2) - (1)	+ 15.9	- 1.	- 6.2	- 4.
Wage bill of foreign skilled labor				
(1) Constraint	77	98.4	34.2	-
(2) No constraint	79.7	94	8.8	-
(3) = (2) - (1)	+ 2.7	- 4.4	- 25.4	-
Human investment				
(1) Constraint	29.3	56.0	56.4	65.2
(2) No constraint	31.8	56.2	54.9	68.4
(3) = (2) - (1)	+ 2.5	+ .2	- 1.5	+ 3.2
Endogenous material investment				
(1) Constraint	72.7	99.5	141.2	186.6
(2) No constraint	70.6	99.9	146.1	187.1
(3) = (2) - (1)	- 2.1	+ .4	+ 4.9	+ .5

Two other features are worth noting on table I-C. One deals with the wage bill of foreigners. To reduce the number of foreigners in 1985, more of them have to be imported in 1975. Expanding education in 1975 means that more teachers are needed in that year and more high school graduates have to be withdrawn from the labor market to attend university. The other feature deals with the intertemporal trade-off between human and material investments. Pushing education in 1975 means reducing material investment during that year and increasing it a decade later.

The strategy selected by the model is to give priority to human investment. Its share of total investments increases from 13.3% in 1970 to 30% in 1980. Thereafter, it declines and reaches 20% in 1990 (see bottom of table I-B). By pushing education at the beginning of the planning period, the cost of skilled labor is reduced at the end, when expatriates are replaced by nationals. As a result, the marginal productivity of capital increases approximately from 15% in 1975 to 18% in 1990. If behavioural patterns remained unchanged, the target growth rate could be raised substantially. It has been assumed, here, that the behavioural pattern would change* and that the Ivory Coast pattern would be closer to the post-war pattern of Italy than to that of Japan.

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* This was expressed by an increase in the subjective rate of discount.

TABLE I-D: DISTRIBUTION OF NATIONAL LABOR FORCE

	Levels (10^6 persons)				Distribution (percent)			
	1975	1980	1985	1990	1975	1980	1985	1990
Students (post-primary)	78.9	126.2	139.0	171.8	6	8	7	7
Skilled labor force:	104.5	126.5	200.5	280.8	(8)	(8)	(11)	(12)
-high skills	17.4	19.6	56.8	94.6	1	1	3	4
-medium skills	97.1	106.9	143.7	186.2	7	7	8	8
Unskilled labor force:	1103.8	1334.2	1583.2	1911.7	(86)	(84)	(82)	(81)
-urban regular industries	319.9	418.9	515.9	603.3	25	26	26	26
-urban traditional services	90.9	162.5	222.6	315.4	8	10	12	13
-rural, South	481.0	595.6	712.6	857.2	37	38	37	36
-rural, North1/	212.0	157.2	132.1	135.8	16	10	7	6
Total labor force	1287.2	1586.9	1922.7	2364.3	100	100	100	100

1/ Including employment generated through cattle breeding.

What is the impact of this educationally oriented strategy on the Ivorian population? The right side of table I-D shows the percentage distribution of the labor force among seven groups. The student population (as a fraction of total labor force) goes through a peak in 1980. The new educated elite starts to have a weight in 1985. Despite the rapid economic growth, the share of the population employed in traditional services increases steadily. The share of the total labor force employed in agriculture hardly declines in the south. It dwindles in the north.

The two classes gaining from growth are the farmers with plantations in the south and the new educated class in urban areas. In the basic scenario, the rapid increase in private savings originates from these two groups. For this reason, the share of government savings can be reduced from 60% in 1970 to 43% in 1990.

II. Alternative scenarios

Let us now consider the five alternative scenarios summarized in table II. When taken one by one, none of the changes appear terribly important. When they are combined, the picture changes substantially in the eighties.

Compare alternatives I and II. In case II, less favorable assumptions are made regarding the scope for import-substitution and export-promotion. In the seventies, the level of consumption is hardly affected but the level of investments is reduced. This leads to a decline of consumption in the eighties. Because there is less scope for import-substitution, the level of imports rises in the seventies and the shadow price of foreign exchange increases. At the same time, the demand for capital and labor is reduced. This induces a decline in the shadow price of savings and a rise of disguised unemployment. Foreign exchange is more valuable, saving is less; one approximately offsets the other. The scarcity value of one additional unit of foreign capital hardly changes.

In case I and II there are tariffs on non-competing imports only. Let us now move to case III by adding tariffs on competing imports. As

TABLE II: ALTERNATIVES

		I	II	III	IV	V	VI
Policies							
Less scope for import substitution and export promotion			X	X	X	X	X
Imposing tariffs on competing imports				X	X	X	X
Reducing, capital imports in 1975, 80, 85					X	X	X
Not allowing imports of agricultural labor					X	X	X
Increasing employment in the North						X	X
Restricting imports of skilled labor							X
Economic Aggregates		← - - - - - - - - Indices (I=100) - - - - - - - - →					
Value of the objective function		100	96	94	92	87	83
Private consumption	1975	100	98	97	97	96	95
	1980	100	100	98	95	93	89
	1985	100	94	93	90	88	85
	1990	100	93	91	91	83	83
Endogenous material investment	1975	100	94	103	81	72	55
	1980	100	80	82	92	85	58
	1985	100	106	89	86	79	82
	1990	100	93	89	88	80	76
Imports (CIF)	1975	100	111	111	102	98	90
	1980	100	102	88	88	82	73
	1985	100	102	82	80	72	71
	1990	100	98	78	82	69	65
Wages of foreign skilled labor	1975	100	83	83	78	77	78
	1980	100	73	73	69	69	31
	1985	100	44	32	82	82	-
Number of high skilled Ivorians	1975	100	100	100	100	100	100
	1980	100	98	96	92	92	98
	1985	100	96	93	86	84	90
	1990	100	93	90	86	82	82
Unskilled labor employed in traditional services	1975	100	116	118	82	90	100
	1980	100	123	142	140	151	232
	1985	100	144	170	172	169	175
	1990	100	120	163	136	119	123
Premium (1980)		← - - - - - - - - Percentage Premium - - - - - - - →					
Foreign exchange		26.0	32.6	27.5	27.5	29.2	32.4
Savings		17.1	12.6	22.7	21.8	65.8	74.7
Foreign capital		42.4	44.7	49.4	48.4	92.3	104.1
Own rate of interest (1975-85)		← - - - - - - Average rate of return - - - - - - - →					
Foreign exchange		15.1	15.3	15.5	15.6	14.9	13.2
Foreign capital		15.4	15.2	14.7	15.1	14.5	11.6

could have been expected, the growth of commodity imports and exports is reduced. Between 1970 and 1990, the average growth rate declines from 6.1% a year to 4.7% a year. Domestic prices of those goods with a high content of competing imports rise and their consumption declines (by 5 to 8% in 1980). By promoting import-substitution, tariffs ease the balance of payments constraint and induce a decline in the foreign exchange premium. This could have been expected. A surcharge on imports reduces the devaluation required to equilibrate the balance of payments. An unexpected development is the large increase in the level of urban disguised employment. The factors responsible for it are summarized below:

Case III - II, 1990	Thousands
Increase in urban disguised employment	130
Increase in imports of Voltaics	100
Reduction in labor requirements:	
Replacement of textiles and miscellaneous exports by less labor-intensive import-substitution industries	13
Lower level of economic activity	17

When tariffs are imposed on competing commodity imports, Voltaics become relatively cheaper to import. Forty percent of their wage is remitted abroad without tariffs. Of the remaining sixty percent, little is spent on competing imports.

The level of disguised urban unemployment has reached an alarming level in case III. To improve the situation, the obvious solution is

to prohibit the arrival of new Voltaics. Along this same nationalistic vein, import restrictions are imposed on capital. As shown in column IV of table II, the employment problem is improved in the years 1975 and 1990 by the prohibition on Voltaics. The

restriction on capital borrowing does not affect the level of consumption in 1975. However, it severely curtails material and human investments. Due to the slow-down of educational activities in the seventies, the number of foreigners imported in 1985 is multiplied two-and-a-half-fold. "L'ivoirisation des capitaux" does not do any good to "l'ivoirisation des cadres".

A progress was made in redeeming unemployment in case IV. Can we do better in case V? The solution, this time, is to launch an agricultural development program in the north. The program provides an additional 180 thousand jobs in the north by the year 1990. In that year, disguised unemployment in urban areas amounted to 420 thousand in case IV. One could therefore expect urban unemployment to be 40% lower in case V than in case IV. This does not occur. Table II shows that, taking the period as a whole, the situation hardly improved. The program requires large government expenditures, which reduces government savings. The shadow price of saving triples and the level of activity slows down. In brief, the objective function drops by five points.

In view of this distressing result, the development program in the north was tested under more favorable conditions by returning to

Table II-8: Development program in the north applied to the basic case.

	(1) + (2) = (3) + (4)	1975	1980	1985	1990
	Employment:	-------- Thousand people --------			
(1)	North	+ 31.4	+ 40.3	+ 103.5	+ 180.4
(2)	South	- 22.0	- 23.0	- 33.0	+ 4.0
(3)	Importation of Voltaics	+ 2.0	- 14.3	+ 13.8	+ 181.2
(4)	Reduction of migration to urban areas	+ 7.4	+ 31.6	+ 56.7	+ 3.6
	Disguised unemployment in urban areas	+ 0.1	- 6.9	-	+ 56.6

the basic case. Even so, the program remains expensive. The economy being healthier absorbs it more easily. The objective function loses only 2.5/ points. But the employment picture does not improve. Consider the year 1990 in table II-B. Rural employment increases by 184 thousand. But 181 thousand new Voltaics arrive. (Recall that imports of Voltaics are free in the basic case). Due to the slow-down of economic activity, urban disguised unemployment ultimately rises by 57 thousand.

After having been side-tracked to case I, let us return to case V and finish with the last experiment. We go one step further in nationalism and impose strict bounds on the import of skilled workers in 1975 and in 1980. After this year, expatriates are prohibited. Again, consumption in 1975 hardly moves. But investments drop dramatically in both years and problems of underutilization of capacity arise. The average rate of economic return (bottom of table II) had remained remarkably stable during the first four experiments. It was shaken in the fifth experiment. It fell markedly in the sixth. The model behaves as if the economy could adjust to import restrictions either on men or on capital. But, when both are restricted at once, the economy takes one decade to adjust.

Annex on Shadow Prices

The shadow prices shown on tables I-E and II have been normalized in terms of the consumption bundles selected in the year concerned. Consequently, for consumption goods, the prices shown in table I-E can be interpreted as price indices, using as unity the price structure which prevailed in the base period.

Table I-E

Among the eight groups of consumption goods, prices go up for housing and for meat*, they go down for traditional food (yams) and transportation. In the case of capacities, the shadow prices measure the rental values, inclusive of interest charges and depreciation. For example, a shadow price of .33 for vehicle capacity means that the rental value of an automobile is one third of the purchase price.

In the case of saving and foreign exchange, shadow prices are expressed in terms of their plus value over consumption. Thus, a 17 percent premium on saving in the year 1980 means that one unit of savings in 1980 is 17 percent more valuable than one unit of consumption during the same year 1980 (in terms of their relative contributions to the value of the objective function). The premium is slightly lower on government revenues than on savings. This is because, when government revenues increase, part of the increment is diverted from investment to financing additional expenditures of the public administration. The 26

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* The meat import price is assumed to rise by 1.5% a year.

1B. Shadow Prices (normalized in terms of aggregate consumption)

	1970†	1975	1980	1985	1990
	--- (Price index 1970 = 1.00) ---				
1. Groups of consumption goods					
Weighted* average of the 8 groups	1.00	1.00	1.00	1.00	
Housing	1.00	1.35	1.36	1.52	
Household durables	1.00	1.04	1.03	1.01	
Transportation	1.00	.76	.76	.73	
Clothing	1.00	.97	.97	.89	
Processed food and beverages	1.00	1.01	.97	.89	
Cereals	1.00	1.10	1.06	1.01	
Meat	1.00	1.36	1.39	1.42	
Traditional foodstuffs	1.00	.63	.63	.78	
2. Capital goods					
Vehicles	1.00	1.14	1.09	1.00	
Machines	1.00	1.06	1.05	1.01	
Construction	1.00	1.04	1.04	1.00	
		--- yearly rental value ---			
3. Capacities					
Vehicles		.29	.34	.33	
Machines		.24	.23	.31	
Construction		.245	.245	.28	
		--- plus value above consumption ---			
4. Saving and foreign exchange					
Saving		.25	.17	.21	.19
Government revenues		.22	.15	.19	.18
Foreign exchange		.27	.26	.23	.26
Grant in foreign exchange		.51	.42	.43	.45
		--- millions F.C.F.A. worth of current consumption ---			
5. Efficiency wages					
L0 unskilled rural	.060	.066	.065	.067	.064
L1 unskilled urban	.100	.095	.094	.094	.086
L2 "ouvrier specialisé"	.35	.17	.40	.19	.13
L3 "ouvrier qualifié"	.85	1.25	1.29	1.05	.72
L4 "employé"	.45	.50	.52	.19	.09
L5 "bachelier lettres"	1.2	1.53	1.73	1.90	1.01
L6 "bachelier sciences"	1.5	1.91	2.17	1.90	1.03
L7 Professional	3.0	3.81	4.33	4.76	3.16
L8 Experienced professional	5.0	6.36	4.33	4.76	3.16

†Market wages estimated for 1970.

*Using for weights the value of each group at curve

percent premium on foreign exchange reflects partly the fact that the volume of coffee and cocoa exports cannot be expanded indefinitely at a constant marginal return. The premium on saving and on foreign exchange combined gives the premium attached to a unit foreign exchange inflow which would never have to be repaid. Such an additional unit would ease simultaneously the saving and the foreign exchange constraints.

In the case of labor, for 1970, the figures are market wage estimates. For the other years, they measure marginal labor productivity. The wage differential between L7 and L8 measures a rent accruing to experience on account of scarcity. This rent disappears by 1980. The fall in the shadow price of L4 reflects the surplus of "employés sans qualification". It is more than another oddity of optimizing models. A preoccupying feature of the present educational system is the number of pupils going through three or four years of secondary schools and ending up as "employés sans qualification". Finally, the general wage decline for high skills at the end of the period reflects the disappearance of expatriates as the marginal source of supply.

Table II and II-A

The shadow prices of foreign exchange vary within relatively narrow margins for the various experiments made. They are consistently higher for 1975 than for 1980, which is due to the unfavorable agricultural export prospects included in the model for that year.

The shadow prices on savings vary much more widely from zero

TABLE III: Relations between shadow prices
(savings and foreign exchange)

	SP,t	EG,t	EGE,t	GNP,t	TINV,t	INVHED,t	C,t	RGTT,t	CF,t	EXF,t	AEXUF,t	IMTT,t	Shadow price
PSX, θ, t	+1						-Δ						$-\sigma$
GS,θ,t	-1	+1	-1		+1	+1		-1	-.6				$-\sigma$
GEG,t		-1	+1	.0458				+.1077					$-\sigma$
GEGE,t			-1			+1							0
DRG,θ,t				a				-1	+.4				$+\sigma - .1077\alpha$
GINV,t					-1								$-\alpha = -\sigma\left[\frac{1.0458 - a}{1 - (.1077)(a)}\right]$
GGNP,t				-1	+1	+1	+1	+.1077					$+\sigma - \alpha$
GINVH,t						-1							$-\alpha$
GC,t							-1						$+(1+s)\sigma = \alpha$
FRCF,t									-1				$+\Phi + \sigma[1 - (.4)(.1077)\frac{\alpha}{\sigma}]$
Fθ,t									+1	.94 + .002t		-1	$-\Phi$
FEXF,t											-1		$(.9853 + .0021t)\Phi$
DEXF,t											+1		$(.9853 + .0021t)\Phi$
DIMTT,t												(.908 + .0015t)	$-\frac{\Phi}{.908 + .0015t}$

(in the two cases added in table II-A) to 8. They may not be extremely meaningful due to their sensitivity to the selection of the saving-consumption parameter.

The own rate of interest of foreign exchange and foreign capital is fairly robust to the policy experiments.

Table III

The precise relations among the shadow prices linked with savings and foreign exchange is shown in table III. The equations of the primal can be read along the rows and the equations of the dual along the columns. Within the first triangle, the shadow prices of the 9 first rows can be expressed analytically in relation to a single one taken as σ, the shadow price of the saving constraint. When the saving constraint is released, these ten shadow prices are equal to zero. Within the second triangle, the shadow prices of the four rows can also be expressed in relation to a single one taken as ϕ for the balance of payment constraint. The two triangles are linked by a row, the shadow price of which can be expressed in relation to σ and ϕ.

INTERNATIONAL DEVELOF T ASSOCIATION | INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT | INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

Project file

TO: Mr. Ernest Stern, Senior Adviser VPD DATE: September 20, 1973

FROM: Jorge Cauas, Director DRC

SUBJECT: Ivory Coast

As per our conversation, please find attached copies of the letters of Messrs. Ouattara and Diawara.

REPUBLIQUE DE COTE D'IVOIRE
UNION - DISCIPLINE - TRAVAIL

Abidjan, le .....

MINISTERE DU PLAN

Le Directeur des Etudes de Développement,

DIRECTION DES ETUDES DE DEVELOPPEMENT

N° D 245 PLAN/ED/EC

à Monsieur GOREUX
Directeur-Adjoint du Centre
de Recherches
Banque Internationale pour
la Reconstruction et le Développement
1818 H Street N. W Washington
D C 20433 U. S. A

Objet : Coopération entre le Centre de Recherches de la Banque Mondiale et les services du Ministère du Plan et participation de Monsieur GOREUX aux travaux des groupes de réflexion prospective en Côte d'Ivoire.

Monsieur le Directeur-Adjoint du Centre de Recherches,

Le principe d'une coopération entre le Centre de Recherches et les services du Ministère du Plan, ainsi que celui de votre participation aux réunions de travail du mois d'Octobre 1973 ayant été acceptés par le Président de la Banque Mondiale, je suis heureux de vous informer du maintien de la date d'ouverture des travaux au 1er Octobre et espère que vous pourrez vous libérer pour cette date.

Comme vous le savez, les travaux des groupes se poursuivront aux mois de novembre et de décembre. S'il vous est, évidemment, impossible d'être présent pendant toute la durée des réunions, je compte fermement sur votre participation, et celle du Centre de Recherches, jusqu'à la fin des travaux de réflexion prospective.

.../...

En ce qui concerne la participation du Centre de Recherches aux phases suivantes de la préparation du Plan, votre Président suggère qu'elle soit examinée dans le cadre d'ensemble du travail économique de la Banque Mondiale sur la Côte d'Ivoire. Notre Ministre s'en entretiendra sans doute prochainement avec Monsieur CHAUFOURNIER.

Afin de compléter l'information nécessaire à votre participation aux travaux des groupes de réflexion prospective, je vous fais parvenir sous ce pli le calendrier des réunions.

Vous constaterez qu'il ménage la possibilité d'un nombre suffisant de séances de travail préparatoire avec les services du Ministère du Plan, ce qui doit faciliter les échanges au cours des travaux et l'adaptation de nos interventions en fonction des préoccupations qui se feront jour au sein des groupes, auxquels une liberté totale sera laissée quant au choix de la démarche à adopter.

A la lumière des travaux déjà réalisés sur le modèle de programmation à niveaux multiples et des réflexions effectuées au Ministère du Plan, il est d'ores et déjà possible de présumer des domaines dans lesquels vous pouvez apporter une collaboration enrichissante aux groupes chargés des réflexions sur les problèmes économiques, l'emploi et l'éducation.

En ce qui concerne les problèmes économiques, dans une optique d'ensemble, je pense que le contenu de la note que vous nous avez présentée, résumant six options de développement correspondant à des degrés d'ouverture sur l'extérieur différents, peut constituer une base solide et fournir l'ossature à une note ou à un exposé sur les stratégies de développement possibles. La présentation des principales hypothèses, contraintes imposées au modèle et des résultats obtenus, sous forme d'un scénario assorti de quelques variantes me paraît la formule la plus adaptée pour engager les discussions sur les problèmes soulevés au sein des groupes. Vous trouverez ci-joint une note sur ce sujet indiquant un certain nombre de points qui mériteraient d'être développés.

Il me parait également utile que les groupes Agriculture, Industrie, Education, Formation, Emploi aient connaissance des problèmes plus spécifiques qui ont pu être mis en évidence à l'aide des sous-modèles ruraux et urbains lors de leur fonctionnement autonome ou articulés au modèle central pour l'étude des six options de politique économique.

Vous trouverez également, dans les pages qui suivent, les points qui ont retenu notre attention dans chacun de ces secteurs.

Veuillez agréer, Monsieur le Directeur-Adjoint du Centre de Recherches, l'assurance de ma considération distinguée.

M. M'LAN OUATTARA

P. J. :

- Double de la lettre au Président de la Banque Mondiale concernant la participation de M. GOREUX aux réunions de travail des groupes de réflexion prospective.
- Calendrier des réunions de travail des groupes de réflexion prospective.
- Notes relatives à la préparation des travaux au sein des groupes :
  - développements pour les problèmes économiques
  - questions intéressant : - le secteur agricole
    - le secteur industriel
    - l'éducation
- informations et statistiques relatives à l'enseignement.

onsieur Robert S. MANAMARA
Président de la Banque Mondiale

PLAN/ED/TC

Monsieur le Président,

Je vous remercie vivement de votre lettre du 14 Août, de l'intérêt que vous y exprimez pour les travaux engagés en vue de la préparation du Plan de développement économique et social pour les années 1971 à 1980 et de votre désir de voir se poursuivre la collaboration fructueuse entre le Ministère du Plan et vos services et en particulier avec le Centre de Recherches de la Banque Mondiale.

Je me réjouis de votre accord pour la participation de Monsieur GOREUX aux travaux qui débuteront à Abidjan au mois d'Octobre, auxquels il apportera une contribution éminemment enrichissante, et espère qu'il pourra se libérer pour le début des travaux.

C'est avec beaucoup d'intérêt que je retiens votre suggestion d'examiner la participation de la Banque Mondiale aux phases suivantes de la préparation du Plan, dans le cadre d'ensemble du travail économique de la Banque Mondiale sur la Côte d'Ivoire, en compagnie du Ministre de l'Economie et des Finances et de Monsieur CHAUFOURNIER.

Je vous prie de croire, Monsieur le Président, à l'assurance de ma considération distinguée.

P. le Ministre

Ivory Coast Project

Proposed Work Schedule

(Fiscal Year 1973)

Item	Completion date
1. Urban Model (Urban and Education revisions and policy experiments)	September 1, 1972
2. Rural Model (South and North revisions, aggregation and policy experiments)	October 15, 1972
3. Urban-Rural model (Urban and Rural links with the Central model and experiments)	November 15, 1972
4. Review Committee Paper	December 1, 1972
5. Ivory Coast papers	Dec. 15-20, 1972
6. Ivory Coast mission	Jan. 10-Feb. 10, 1973
7. Model revisions and clean-up	March 15, 1973
8. Monograph - 1st draft	May 1, 1973
9. Monograph revisions	June 30, 1973

Mr. J. Cauas, Director, DRC August 20, 1973

Ernest Stern, Senior Adviser, VPD

Ivory Coast Project

1. As we agreed, this project should have at least as much priority for the Region as for us, so that we should do no more than match their contribution. Pending Mr. Chaufournier's return, I suggest we allocate $2700 at this time and the remainder ($2300) after the Region has committed their balance. The initial $5400 is ample to start on Monday.

2. Since it is difficult at this early date to properly forecast savings in DPS Departments (and even more difficult to get anyone to release them), I suggest that, for the time being, you fund this from Departmental funds. At the time of the mid-year review (January), and with revised budget requirements, the DRC will be given first call on any savings which, I am confident, will be available. Should this not work out for any reason, we could, as a last resort, reinstate the Ivory Coast project for FY1974 research funding.

bcc: Messrs. Chenery, Smith
PESmith/EStern:lm

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Correspondents / Participants
To: Ernest Stern
From: Jorge Cauas, Director DRC

Subject / Title
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INTERNATIONAL DEVELOP T ASSOCIATION | INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT | INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

TO: Mr. Ernest Stern, Dev. Policy DATE: August 15, 1973

FROM: Jorge Cauas, Director DRC

SUBJECT: Ivory Coast

Please find attached a copy of the letter sent my Mr. McNamara to Mr. Diawara with reference to their request for Bank participation in the preparation of the 1976/80 Plan.

Mr. Goreux and Mr. A.R. Gué are preparing the draft of the terms of reference for Mr. Goreux's participation in the working sessions to be held in Abidjan in October.

cc. Mr. Louis Goreux

AUG 14 1973

Monsieur le Ministre,

Je vous remercie bien vivement de votre lettre du 23 juillet et de l'intérêt que vous portez aux travaux de recherche effectués par l'équipe de M. Goreux sur l'économie ivoirienne.

C'est avec plaisir que nous acceptons le principe d'une coopération entre notre Centre de Recherches et vos services dans la préparation du prochain Plan. Aussi, nous serions très heureux de voir M. Goreux participer aux réunions de travail qui auront lieu à Abidjan en octobre.

En ce qui concerne notre participation aux phases suivantes de la préparation du Plan, je suggère qu'elle soit examinée dans le cadre d'ensemble de notre travail économique sur la Côte d'Ivoire. M. Chenderlier aura certainement l'occasion d'en discuter avec vous et avec Son Excellence le Ministre Konan Bédié lors de la réunion annuelle à Nairobi.

Je vous prie de croire, Monsieur le Ministre, à l'expression de ma haute considération.

(Signed) Robert S. McNamara

Robert S. McNamara

Son Excellence
Monsieur (Signed) R. Mamara
Ministre du Plan
Abidjan, Côte d'Ivoire

AHCué:tp
8/13/73
cleared with and cc. Mr. Cenac
cc. Mr. Knudsen

UNOFFICIAL TRANSLATION

Dear Mr. Minister:

I wish to thank you for your letter of July 23 and for your interest in the research work performed by Mr. Goreux' team on the Ivorian economy.

We gladly accept the principle of a cooperation between our Research Center and your Ministry in the preparation of the next Plan. We would, therefore, be pleased to have Mr. Goreux attend the working sessions that you are planning to hold in Abidjan in October.

As far as our participation in the next preparatory phases of the Plan is concerned, I would suggest that it be examined in the global framework of our economic work on the Ivory Coast. Mr. Chaufournier will certainly have the opportunity to discuss this with you and His Excellency Minister Konan Bédié at the Annual Meeting in Nairobi.

Sincerely,

Robert S. McNamara

OFFICE MEMORANDUM

TO: Mr. Jorge Cauas

DATE: August 7, 1973

FROM: Louis Goreux LG

SUBJECT: Diawara's Letter

Before answering Diawara's letter, a choice has to be made between two courses of action, which are mutually exclusive. They are outlined below:

1. No additional expenses

The DRC documents left in Abidjan can be used by the Ministry of Planning. Requests for clarification can be answered by mail. As soon as a complete draft of the manuscript is available, it will be mailed to Abidjan for comments.

2. Additional expenses

2.1 Participation in the "groupes de reflexion a long terme".

Prior to a visit in October, a number of revisions are made in the educational part of the model. These revisions take into account (i) the comments received from Abidjan; (ii) the findings of the UNESCO/IBRD mission on education; (iii) the work conducted by the IBRD team on employment.

The total cost is estimated at 10,000 dollars:

Computation	6,000
of which	
Revision of the educational matrix	(1,500)
Testing	(2,000)
Solutions	(1,500)
Renting of discs, reproduction of tapes for Abidjan	(1,000)
Programmer	1,000
Visit	3,000
	10,000

The computation would be conducted over the period August 15 through September 15. The total staff time involved would be approximately

Goreux	8 weeks
P. Davis	3 weeks

2.2 Technical Assistance in the beginning of 1974 for the preparation of the 1976/80 Plan.

This could take the form of a 3 to 4 weeks visit to Abidjan just after completing the first draft of the manuscript and sending it to the reviewers. The cost involved would be:

Visit	3,000
Transfer of tapes and minor computation	2,000
Total	5,000

Summary

On the minus side, the second solution implies a 15,000 expenditure and a two-months delay in the completion of the manuscript. On the plus side, it strengthens the policy discussion in the book and the impact of the research project on planning in the Ivory Coast.

REPUBLIQUE DE COTE D'IVOIRE
UNION - DISCIPLINE - TRAVAIL

MINISTERE DU PLAN

DIRECTION DES ETUDES
DE DEVELOPPEMENT

N° D 227 PLAN/ED/EC

Abidjan, le 20 JUIL. 1973

Le Directeur des Etudes de Développement,

Monsieur L. GOREUX
BIRD
1818 H Street
N.W. - Washington
D.C. 20433 - U.S.A.

Monsieur,

Je vous prie de bien vouloir trouver ci-joint copie d'une lettre adressée à Monsieur Mac Namara, Président de la Banque Internationale pour la Reconstruction et le Développement, au sujet de votre venue en Côte d'Ivoire dans le cadre des travaux Long Terme effectués sous la responsabilité du Ministère du Plan.

Je vous joins également un ensemble de documents diffusés à l'occasion de la réunion des groupes internes de réflexion prospective.

Je vous prie d'agréer, Monsieur, l'expression de ma considération distinguée.

REPUBLIQUE DE COTE D'IVOIRE
DIRECTION DES ETUDES DE DEVELOPPEMENT
LE DIRECTEUR
MINISTERE DU PLAN

M. M'LAN OUATTARA.

23 JUL 1973

Monsieur le Président,

A la suite de la mission que vient d'accomplir M. COLLIOU du 11 au 22 Juin à Abidjan, je tiens à vous dire tout l'intérêt que je porte aux travaux de modélisation entrepris par le Centre de Recherche de la Banque Internationale pour la Reconstruction et le Développement concernant l'économie de la Côte d'Ivoire.

Lors de son séjour à Abidjan, M. COLLIOU m'a présenté les derniers développements des travaux menés par votre centre en collaboration avec mes services et ceux du Ministère de l'Economie et des Finances, de l'Agriculture, de l'Education Nationale et l'Autorité pour l'Aménagement de la Région du Sud-Ouest.

Compte-tenu de l'intérêt de ces recherches, je suis désireux de voir se poursuivre notre collaboration dans le cadre de la préparation du Plan de Développement Economique et Social pour les années 1976-1980.

Lié à ce programme, mon département a entrepris des études sur les possibilités et les problèmes de développement à long terme de la Côte d'Ivoire. A cette occasion nous avons associés les personnalités ivoiriennes les plus compétentes dans les différents domaines de la vie économique et sociale.

Les groupes de travail constitués se réuniront en Octobre et Novembre prochains. Les conclusions de leurs travaux donneront lieu à des débats sur les problèmes économiques et sociaux et devront déboucher au début de l'année prochaine, sur la définition des options fondamentales et des grandes orientations dans lesquelles devra s'inscrire le prochain Plan.

.../

Je souhaiterais que l'équipe du Centre de Recherche de la Banque Mondiale prenne part à ces travaux ; M. COUDERT pourrait participer, au mois d'Octobre, à Abidjan, aux réunions des groupes de réflexion prospective et y exposer les fruits des recherches jusqu'ici menées.

Son concours serait par ailleurs utile dans les phases suivantes de la préparation du Plan, et on pourrait prévoir à Abidjan un séjour de l'année 1974.

Je apprécierais au total pouvoir compter sur la coopération de la BIRD et de son Centre de Recherche dans les formes qui précèdent.

Veuillez croire, Monsieur le Président, à l'expression de ma considération très distinguée.

M. T. DIAWARA. -

Monsieur MAC NAMARA
Président de la Banque Internationale
pour la Reconstruction et le Développement
[illegible] Street N. W.
WASHINGTON DC 20433
U. S. A.

MR STERN

ROUGH DRAFT

July 5, 1973

Mr. Roger Chaufournier

Louis Goreux

Ivory Coast

As you may recall, I have been in Abidjan from June 12 to 22 to discuss with the Ivorian Administration the results of a long-term study of the Ivory Coast economy. It went very well with the Ministry of Finance, the Ministry of Planning, l'ARSO and the Ministries of Education and Scientific Research.

I was quite impressed with the organization. Following your letter to Bedie and my letter to Uzel (Kone's advisor), a meeting was organizaed for the day of my arrival; a copy of the "convocation" is attached. Approximately 35 representatives of the various ministries and services attended. A series of 8 seminars was arranged at the end of this meeting. The attendance at each seminar was between 10 and 20 and the discussion was good.

L'ARSO, the Finances and the Plan expressed the wish of some follow-up, called by Uzel (Finance) "service apres vente". Diawara was rather keen on having something start quickly. I took neutral position and told him that if he wanted something, he should write to the Bank. I informed the Chief of the IBRD Mission in Abidjan of my discussions and I had a few words about it with Ernie Stern in Israel. Both suggested that I provide you with some background in case a letter should reach you.

The proposal of Diawara on June 22 covered a short-term (prior to October 5, 1973) and a medium-term (prior to June, 1974) aspects. The first one is linked with the "commissions de reflexion sur le long term". Those are to start mid-September and to end about Christmas with the presentation of a report to (Houfhouet). The second one is linked with the preparation of the "esquisse du IIIe Plan" to be submitted to the political bodies by mid-year 1974.

I shall start with the short-term problem. Diawara's idea is to involve at an early stage political bodies in the elaboration of the major objectives of the Plan and in the broad policy choices. The more technical preparation of the "esquisse du Troisieme Plan" would follow. The idea appears politically sound.

La CETEF (Florenzano's cabinet) was asked to prepare the basic documents. This created some frictions within the staff of the D.E.D.

I have read in Abidjan some of the CETEF papers and I am supposed to see Florenzano in Paris. The "document de synthese" is a very well written paper (90 pages) describing the trends to date and highlighting the problems emerging. The documents on the "long terme" were not yet available. There are some doubts on the validity of the approach followed.*

After reading our documents, in particular the one called "Options de Politique Economique", Diawara decided** that our results should be presented and discussed at the "Commission de reflexion sur le long terme". For information, the typical commission is composed of about fifteen

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* Florenzano follows somewhat the lines of the Hudson Institute's "L'an 2000".

** Situation on June 22.

influential Ivorians selected among memebers of the Assembly,high-level civil servants, etc.

It was suggested to proceed in four steps. First, several possible scenarios corresponding to different solutions of the model will be described, using diapositives for illustration. (slides) Second, the members would be asked to propose other objectives and other policy constraints. Third, the model would be rerun in Abidjan after incorporating some of the proposals made. Fourth, the implications of these proposals would be presented and discussed with the Commission. These four steps could take place between September 20 and October 10.

Between now and September, the program would be the following: (1) Prior to August 1, some economists in the Plan would study the IBRD model in more detail and propose changes. (2) One economist of the Plan would come to Abidjan in August for revising the model.

In the short-term program, it was suggested to concentrate the efforts on a revision of the educational part for three reasons: (a) It is topical; (b) it sells very well; (c) most members of the "Commission a long terme" are also members of the "Commission de Reforme de l'enseignement" which has to make proposals soon.

If a letter is not received from Abidjan in July, the short-term aspect described above can be forgotten. If a letter is received and if IBRD wishes to respond positively, the following financial implications would ensue: (i) One month programmer (Nguyen) in August (approximately $1,000); (ii) $5,000 computer funds; (iii) one three-week trip to Abidjan.

I shall now turn to the long-term aspect. Diawara accepted the proposal presented to him by the DED. A programmer and an economist would be recruited to deal with the IBRD models, starting September 15. A provision of 7 million CFA would be made for computation. This unit could take care of the additional computation required by the ARSO. However, from the IBRD side, it might require another visit to Abidjan for the preparation of the IIIe Plan.

I am aware of the need to keep a proper balance between the various ministries. Bedie was not there; I saw only Kone who reacted very favourably. Uzel, the advisor of Kone, will not be back in Abidjan before mid-August. It would therefore be useful to keep MARTIN (President) informed of any development. I found him quite useful and he is fully briefed.

Yours sincerely,

Louis Goreux

INTERNATIONAL DEVELOPMENT ASSOCIATION | INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT | INTERNATIONAL FINANCE CORPORATION

Project File

670-04 Mr Stern

OFFICE MEMORANDUM

TO: Files

DATE: February 27, 1973

FROM: Charles R. Blitzer C.R.B

1975 OCT -3 PM 1:04

R.S. E-4

SUBJECT: Summary of the Technical Review Seminar of Ivory Coast Project (February 16, 1973).

1. Attending the day-long seminar, in addition to the members of the Project Team, were M. Ahluwalia (Chairman), B. Balassa, C. Blitzer (Rapporteur), J. Cauas, H. Chenery, J. Duloy, A. Manne, and G. Pursell.

2. This summary is meant to highlight the major points which were discussed. In no way is it meant to be a comprehensive record of what was said by each participant.

Background and Objectives of Project

3. L. Goreux reviewed Ivory Coast economic development during the 1960's and the planned objectives and basic strategy for the 1970's. Since 1960, the major stimulus for growth has been increased exports of primary products, including coffee, cocoa, and especially lumber. Considerable emphasis on import substitution in the manufacturing sectors is planned for the 1970's. Combined with this is the so-called "Ivorization" Policy to replace foreign workers (largely French) with Ivorians in the urban sectors. In the official plans, 1980 is the target for fulfillment of this policy. In the rural sectors, the major problem is the wide gap in income levels between the South, well suited for export crops and relatively modern in technology, and the North, a more arid region characterized by traditional subsistance agriculture.

4. The Ivory Coast Project has been conceived to shed additional light on the official Plan and strategy regarding feasibility, efficiency, costs of particular projects, etc. The rural models are aimed at investigating optimal cropping patterns under different policy and cost assumptions. The urban and educational models are focused on problems of Ivorization and import substitution. The Central Model is to tie up the various parts so that economy-wide consistency is maintained.

5. In addition to providing a set of useful planning tools for the Ivory Coast, the models have been constructed to investigate a number of methodological issues in the realm of multi-level planning.

6. The seminar, however, focused primarily on the state of results of the models and their direct usefulness to the Ivorians.

Rural Models

7. R. Vaurs reported on the results of the various models of the rural sectors. These models are at three levels of aggregation -- large projects, regional areas, and the rural sector as a whole. Having different aggregation levels allows for more detail at lower levels, while maintaining reasonable computer costs.

8. The major conclusion from these exercises, on which most discussion was centered, was that the official plans appeared unfeasible without large subsidies, especially after 1980. In particular: 1) the Southwest rubber estate project would only be profitable with a 30% foreign exchange premium; 2) heavy subsidies would be required for development of the North to proceed as planned.

9. While the conclusions appeared qualitatively sound, they are very much influenced by various assumptions about labor cost and availability. Rural-urban migration is set exogenously at continued high levels; wage costs are assumed to rise at about 2% per year; all productivity gains are realized through transformation from traditional to modern techniques.

10. It was felt that further experimentation should attempt to relax all of these key assumptions in order to investigate their quantitative and qualitative effects. In addition, a foreign exchange premium might be an important tool for moving the sector closer to the official plan.

11. J. Loup discussed the results from the livestock model. These indicate continued imports during the planning period, but at lower levels than officially projected. Land shortages will become acute in the 1980's, indicating need for more modern techniques and careful land allocation between farming and husbandry.

Education Model

12. The education model is designed to investigate the feasibility of the official targets for "Ivorization". Requirements for various labor skills are exogenously set, partly through usage of the urban model. Then, the model chooses appropriate flows through the school system to minimize the costs of meeting these targets.

13. The major conclusions, as reported by A. Condos, is that the official "Ivorization" Plan is not feasible under a wide variety of alternative assumptions. Although this conclusion appeared quite acceptable, questions were raised regarding extensions. Namely, what education policies were feasible and what was their cost trade-off.

14. In addition, some points were raised regarding assumptions made which limit substitution choice in the student flow. These seem especially important in light of the key role played by initial and terminal conditions which tend to produce over-rigidity in linear system.

Urban Model

15. Due to time limitations, introductory remarks were dispensed with and A. Condos immediately proceeded to field questions. A number of questions were raised regarding the reported results. The major issues included: 1) comparison of results and sectoral definitions with the central model and the official plan; 2) widely varying growth rules over time, especially for competitive manufacturing.

16. As an explanation for these puzzling growth patterns, A. Condos pointed out the existence of large excess capacity in the first years. It was suggested that the initial conditions were too flexible and that 1972 should be taken as largely exogenous. In addition, the lack of formal terminal constraints, giving the model only 3 real endogenous periods, might be affecting results in an important way.

Central Model

17. Since the Central Model has not been solved, most discussion was centered on its formulation and the results from a small-scale preliminary version . It was agreed that since these preliminary results appeared sound, that carrying this sort of formulation into the full Central Model was highly promising.

18. In the Central Model, all rural-urban migration is absorbed into the economy through low productivity services. Questions were raised about the realism of this assumption and whether alternatives could be tested. Also, the model might be sensitive to its subjective parameters, such as the subjective discount rate of the utility elasticity of consumption.

Near-term Strategy

19. After the seminars, it was decided that for the period before the results are to be presented to the Ivorians, further work should be more narrowly focused. The Central Model will receive the highest priority, with the objective of obtaining a reasonable basic case. Some parametric testing will be done with the rural models also. Work on the Education Model will be mainly focused on presentation of results and several alternative cases. Further work on the urban model will be postponed.

cc. Messrs. M. Ahluwalia, B. Balassa, J. Cauas, H. Chenery, P. Clark, A. Condos, Miss P. Davis, Messrs. J. Duloy, L. Goreux, J. Loup, A. Manne, G. Pursell, E. Stern, A. Stoutjesdijk, R. Vaurs

INTERNATIONAL DEVELOPMENT ASSOCIATION | INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT | INTERNATIONAL FINANCE CORPORATION

Project file

OFFICE MEMORANDUM

TO: Files

DATE: February 21, 1973

FROM: Bela Balassa

SUBJECT: Comments on Ivory Coast Models

1. This note will summarize the comments I made on the Ivory Coast models at the seminar held on February 16. The comments concern the Rural Models, the Urban Model, and the Central Model. For lack of time, I have not read the paper on the educational model, nor have I participated in its discussion.

Rural Models

2. The Rural Models are of high technical quality and, with some changes in the assumptions, they should provide valuable results for the Western Africa Department as well as for the Ivorians. In the following, I will indicate the implications of certain assumptions for the results obtained and will make recommendations for changes in these assumptions. This will be done separately for the North and the South Models.

3. In its present form, the North Model assumes (a) a 2 percent annual rate of increase of wages, including wages to migrants from Upper Volta; (b) no change in productivity other than through the choice among technological alternatives; (c) a decrease in the supply of local labor from 190 thousand in 1972 to 80 thousand in 1990; (d) unchanged product prices; and (e) the shadow exchange being equal to the actual exchange rate throughout the period. Assumptions (a) and (c) represent the continuation of past trends, while (b), (d), and (e) reflect lack of information on possible changes.

4. Given these assumptions, the optimizing solution of the model shows small increases in agricultural production during the seventies and stagnation during the eighties, accompanied by declining land use and rapidly increasing wage payments to migrants (p.31). In turn, taking the Five-Year Plan's production targets as exogenous, one gets explosive increases in wage payments to migrants and declining net social regional returns (p.34).

5. The results are explained if we consider that, in the absence of increases in product prices, productivity (for a given technique), and the exchange rate, the rise in wages would lead to a deterioration of the competitive position of Ivorian producers, and regional welfare would be adversely affected by the assumed pattern of migration also. But one should not extrapolate trends in either wage changes or migration. Wage changes could be made dependent on increases in productivity while a rising supply curve for migrant workers should be assumed in conformity with the Central Model. Nor will the extrapolation of past trends be appropriate for the outmigration of local labor since preferences as regards income, the risk of unemployment, and location differ among individuals. If we take account of these factors, a deceleration of migration would ensue.

6. The assumptions made as regards productivity and exchange rates should also be modified. One may borrow the assumption of productivity growth from the Central Model, combining it with shifts in techniques in the North Model, and adopt the 25 percent increase in the exchange rate obtained in

the Central Model. I would recommend that new computer runs be made reflecting these assumptions as well as the suggestions of the preceding paragraph, prior to the mission to the Ivory Coast.

7. The results of the South Model depend to a considerable extent on the assumptions made in regard to the future course of coffee and cocoa prices, wages, and migration. On the basis of these assumptions, the conclusion is reached that production would rise at a rapid rate, with smaller increases in regional value added due to greater reliance on imported labor (p.40). The assumptions on wage changes and migration should be reviewed for this model also, and explicit consideration should be given to the implications of the export tax on coffee and cocoa for foreign exchange earnings. While in the present version export taxes are used as policy variables to affect income distribution (p.29), their more conventional role in maximizing foreign exchange receipts would need to be separately considered. Attention should further be given to the incentive effects of export taxes.

The Urban Model

8. In commenting on the Urban Model, I will concentrate on the numerical results obtained. If, for comparability with the Central Model, one takes the case with a 10 percent discount rate, a 25 percent foreign exchange premium, and the continuation of the present tax and tariff structure, the production of competitive manufacturing shows annual increases of 70 percent in 1972-75, 18 percent in 1975-80, 11 percent in 1980-85, and 1 percent in 1985-90 (p.43). These results do not appear reasonable and contrast with the smooth changes of manufacturing production obtained in the preliminary version of the Central Model which does not contain extreme values. Nor does the behavior of gross investment appear reasonable as this would involve substantial increases in marginal capital-output ratios between 1972-75 and 1975-80. Finally, questions arise as regards the lack of sensitivity of the results to variations in the exchange rate premium from 0 to 75 percent (Cf. pp.38-44).

9. In the course of the discussion, it has been suggested that the behavior of marginal capital-output ratios can be explained by the elimination of excess capacity between 1975 and 1980. This however assumes that capacity is fungible within each of the eight industries (e.g. shoe manufacturing capacity can be used in producing clothing) and that the underutilization of capacity is exclusively demand-determined. Neither of these assumptions is realistic, however, and thus we cannot postulate that excess capacity would be eliminated within a short period as demand for manufactured goods increases.

10. The peculiar behavior of the model in the first half of the seventies should further be noted. From the table on p.32 it appears that even in the most favorable case when taxes and subsidies are maintained, the interest rate is 10 percent, and there is a foreign exchange premium of 75 percent, competitive manufacturing production would decline from Cfa 59 billion in 1970 to 29 billion in 1972, only to increase again to 120 billion in 1975. In the absence of detailed information on the structure of the model, it is difficult to explain these results. But the lack of initial conditions on output has necessarily affected the estimated pattern of manufacturing production in the model as the figures for the initial year (1972) do not correspond to actual magnitudes but were derived from the model itself. In turn, the lack of terminal conditions appears to have influenced the behavior of investment while the

rigidity of the model may explain the unresponsiveness of the results to changes in the exchange rate.

The Central Model

11. The Central Model shows considerable originality, especially as far as the formulation of the objective function is concerned. It also deserves kudos for having obtained what may be considered reasonable results in its preliminary version within a very short time. In the following, questions will be raised concerning the assumptions of the model as regards the process of urbanization. Furthermore, suggestions will be made on possible uses of the model that offer general interest.

12. In the Central Model, rural-urban migration is taken to be exogenous and it is assumed that migrants who do not find other occupations will be absorbed in traditional services, thereby raising the proportion of unskilled workers in this sector from 20 percent in 1970 to 50 percent in 1990 (p.23). With decreasing productivity in traditional services, the efficiency price of unskilled workers would decline at an annual rate of 1.5 percent as against an increase of 3.4 percent for rural workers. However, equalization between the wages of urban and rural labor would be reached only in 1985 and, by assumption, this would not affect the pattern of migration (p.26).

13. The full absorption of the unemployed into the traditional service sector does not appear to be a realistic assumption. It would seem more appropriate to assume partial absorption, together with the continuing operation of the "big family" system under which those who have found jobs provide for unemployed relatives. Also, migration should be taken to be endogenous rather than exogenous of the model. We will then not have the increase in unemployed and decline in the efficiency price of urban labor obtained in the present version of the model.

14. Let me add, finally, that the model in its complete form offers an interest that transcends its usefulness for the Ivory Coast. In particular, it appears to provide an excellent vehicle for investigating the impact on shadow prices of changes in the objective function, in policy constraints, and in some of the exogenous variables. It can also be used to indicate the pattern and cost of incentives in effective protection terms and to examine the potential effects of changes in trade policies on resource allocation and welfare, with account taken of budgetary constraints. Such work could be usefully undertaken after the results of the complete model are presented to the Ivorians in April.

cc. Messrs.

Chenery	Goreux	Ahluwalia
Stern	Condos	Blitzer
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Manne	Vaurs	Stoutjesdijk

EBalassa:alm

RESEARCH PROJECT NAME: Ivory Coast Programming Models

RESEARCH PROJECT NUMBER: RPO 204

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Contracts	Disbursements through Aug. 31	Forecast Disbursements for FY 73, based on				Forecast Total Disbursements FY 1973	FY 1974
		Signed Contracts	Firm Commitment	Tentative Commitment	Planned Commitment	(2)+(3)+(4)+(5)	
	(1)	(2)	(3)	(4)	(5)		
Manne	-	6.0				6.0	
Myers	.5	2.4	2.7			5.1	
Inman	1.4	1.4				1.4	
Harris	.4	.4				.4	
Vinh	.5	.5				.5	
Nguyen				3.5		3.5	
Kornai			1.5			1.5	
Olivier			.7			.7	
Sub-total:		10.7	4.9	3.5		20.1	
Travel				12.6		12.6	
Data Processing	1.0	1.0		24.0		25.0	
Total:		11.7	4.9	40.1		56.7	

Source: (1) From printouts.
(2) DRC estimate.
(3) Firm commitment lacking only formal contract.
(4) Consultant identified but agreement not yet reached.
(5) Contractor not yet identified.

VR.S M2

Banque Mondiale
Centre de recherches
Février 1973

Projet de recherche sur la Côte-d'Ivoire

UN SYSTEME DE MODELES DE PROGRAMMATION POUR LE SECTEUR PRIMAIRE DE LA COTE-D'IVOIRE

Résultats du secteur élevage

Ce document présente les résultats du modèle étudiant le développement de l'élevage et de la pêche. Ce modèle est inclus dans un système de modèles couvrant le secteur primaire de la Côte-d'Ivoire.

Cette étude fait partie du projet de recherche de programmation à niveaux multiple avec application pour la Côte-d'Ivoire.

Auteur: Jacques Loup

Table des métières

Part I : Les résultats de la variante de base

Dans cette section et les suivantes nous désignerons, sous le nom de "variante de base", la version obtenue à partir de l'ensemble des statistiques recueillies en Côte-d'Ivoire. Les résultats de cette variante de base ont été controlés et analysés afin de définir d'autres variantes. Celles-ci ont été déterminées en fonction du changement de certains coefficients qui apparaissaient particulièrement sensibles et/ou peu sûrs. Nous présenterons d'abord les résultats de la variante de base avant de les comparer aux prévisions du plan quinquennal ivoirien.

1. Les résultats

Les principaux résultats de la variante de base apparaissent dans deux tableaux à la fin de cette partie, page 9 et 10.

(a) Elevage de petit bétail et pêche

Nous considérerons d'abord les résultats concernant les activités d'élevage du petit bétail et de pêche. Du fait de l'incertitude des données utilisées, il est souhaitable de ne pas accorder trop de confiance aux résultats obtenus tant que les coefficients utilisés n'auront pas été sérieusement controlés. Du fait de leurs coûts peu élevés, les techniques traditionnelles d'élevage de la volaille, des ovins, des caprins et des porcins sont, bien sûr, les plus intéressantes. En conséquence, elles sont utilisées au maximum dans le modèle. Mais du fait que nous avions imposé certaines limites supérieures à ces activités traditionnelles, la production de viande est ensuite prise en charge par les techniques modernes dans le cas de la volaille

et des porcins et par l'importation dans les cas des ovins et des caprins.

Dans la première section de l'annexe technique, nous avons expliqué comment nous avons fixé pour le modèle une "demande supplémentaire" pour la viande. Cette demande supplémentaire peut être satisfaite par n'importe laquelle des activités d'élevage. En fait, le modèle choisit l'élevage de volaille pour faire face à cette demande excédentaire. Ceci confirme simplement le fait que la viande de poulet peut être produite à un coût peu élevé. De manière similaire pour les activités de pêche, la technique traditionnelle apparaît la moins coûteuse, suivie ensuite par la technique moderne; celle-ci semble de toute manière plus intéressante que l'importation.

(b) L'élevage des bovins

Les résultats les plus importants sont les suivants:

- production de viande : Le déficit actuel de production de viande bovine (par rapport à la consommation) devrait persister dans les années à venir. Toutefois, l'importance relative de ce déficit devrait diminuer.

Quantités de viande exprimées en tonnes de carcasse+ abats

	1972	1975	1980	1985	1990
Consommation	46,806	51,800	73,500	102,100	143,400
Production	4,240	9,610	12,390	22,490	50,510
Consommation/(%) production	9%	18,5%	17%	22%	35%

- techniques d'élevage et d'embouche. La technique la plus intéressante aussi bien pour l'élevage que pour l'embouche semble être la technique traditionnelle. Ceci est dû, bien sûr, à ses coûts peu élevés qui compensent au-delà ses rendements peu importants (en termes de poids des animaux).

Dans la mesure où elle entraîne des dépenses supplémentaires, la technique améliorée semble moins intéressante que la technique traditionnelle et le modèle la rejette.

Puisque la technique traditionnelle d'élevage du bétail utilise de la terre et que l'offre de terre est limitée, l'expansion de cette technique ne peut pas se poursuivre indéfiniment. Nous avons supposé que 4 millions d'hectares étaient disponibles pour ce type d'élevage. Du fait de l'accroissement de taille du troupeau traditionnel, cette limite devrait être atteinte avant 1980, après quoi, il serait nécessaire d'utiliser des techniques plus intensives. A cet égard, les techniques choisies pour les deux races de bétail (N'damas et Zébus) sont très différentes en dépit de certaines ressemblances.

Conformément au modèle, il semblerait plus intéressant de continuer l'élevage de Zébus dans la technique traditionnelle. Puisque les possibilités d'utilisation des terres pour cette technique traditionnelle sont limitées, l'expansion des Zébus se fera aux dépens des N'damas. De fait, l'élevage des N'damas dépend de plus en plus au cours du temps de la technique d'élevage sur pâturages irrigués.

En ce qui concerne la technique de ranch, elle n'apparaît pas intéressante avec les coefficients retenus dans cette variante. En fait, cette technique n'apparaît dans le modèle que parce qu'elle y a été forcée par

une contrainte; celle-ci a pour but de rendre compte du troupeau initial élevé en ranch en 1972.

Les techniques d'embouche choisies par le modèle diffèrent suivant la race et les techniques d'élevage initial. Cependant, ces techniques d'embouche présentent certaines caractéristiques communes :

Les techniques à double transfert (une année en technique améliorée en ranch suivie de 1 ou 2 ans en technique irrigée) ne sont jamais choisies. Ceci indique que ces techniques apparaissent moins intéressantes que les techniques à transfert unique que le modèle a sélectionnées.

En ce qui concerne ces techniques à transfert unique, la durée de la période d'embouche n'excède jamais un an. En d'autres termes, les veaux sont abattus quand ils ont deux ans et il ne semble jamais intéressant de prolonger l'embouche jusqu'à ce qu'ils aient 3 ou 4 ans.

Pour présenter plus en détail les techniques d'embouche sélectionnées, il importe de distinguer entre les deux races d'une part et les techniques d'élevage d'où les veaux sont originaires d'autre part.

La race N'dama :

Les veaux originaires de la technique d'élevage traditionnelle seront embouchés dans cette même technique aussi longtemps qu'il y aura de la terre disponible. Une fois que la contrainte de terre est atteinte, l'embouche est prise en charge par la technique de jachère à stylosanthes qui utilise moins de terre. De la même manière, les veaux nés en ranches seront embouchés sur jachère. Enfin, les veaux nés sur pâturages irrigués seront embouchés sur ces mêmes pâturages.

La race Zébu:

La situation est très similaire au cas des N'damas. Cependant, tous les veaux Zébus sont originaires de la technique traditionnelle puisque l'ensemble des vaches Zébus sont élevées dans cette technique. De même que pour les N'damas, les veaux Zébus nés dans des troupeaux traditionnels seront embouchés dans cette même technique aussi longtemps qu'il y aura de la terre disponible, c'est-à-dire jusqu'en 1980 au plus tard. Ensuite, l'embouche sur jachère prend le relais. Les veaux sont alors transférés de la technique traditionnelle où ils sont nés à une jachère où ils sont embouchés pour un an.

Ces changements dans les procédures d'élevage et d'embouche auront les résultats suivants sur la taille du troupeau:

Unité : Tête de bétail — Variante de base

	1972	1975	1980	1985	1990
Troupeau N'dama élevé:					
En technique traditionnelle	363,240	436,630	483,430	464,570	456,420
En technique améliorée	-	-	-	-	-
En ranches	3,560	6,380	7,780	7,340	7,760
Sur jachère à stylosanthes	1,460	24,300	71,880	78,610	84,360
Sur pâturages irrigués	1,100	4,090	130,130	696,680	2,404,650
Sous-total N'dama	369.360	471,300	693,220	1,247,200	2,953,190
Troupeau Zébu élevé:					
En technique traditionnelle	61,160	57,830	53,750	61,350	67,900
En technique améliorée	-	-	-	-	-
Sur jachère à stylosanthes	100	2,860	2,390	3,510	4,400
Sur pâturages irrigués	-	-	-	-	-
Sous-total Zébu *	61,260	60,690	56,140	64,860	72,300
Total bétail	430,620	531,990	749,360	1,371,060	3,025,490

*Cette croissance apparemment anormale du troupeau de Zébus (d'abord décroissant et ensuite croissant au cours du temps) est due au fait qu'en 1972 une part importante du troupeau est composée de veaux (environ 8.000). Ces veaux seront tous abattus avant ou après 1975, de là la diminution dans la taille du troupeau.

La croissance du troupeau ivoirien change de manière importante aux environs de 1980. Ceci est dû au changement des techniques d'élevage et d'embouche qui devrait se produire environ à cette époque. Lorsque les possibilités d'exploitation des techniques traditionnelles atteignent leurs limites, des techniques modernes consommant moins de terre doivent prendre le relais. Comme celles-ci entraînent une amélioration importante des paramètres démographiques du bétail, il s'ensuit une augmentation rapide de la taille du troupeau. Cette question sera reprise dans la section suivante et dans la deuxième Partie, section 3.

2. Comparaison avec le Plan Ivoirien

Le Plan Ivoirien pour 1971-1975 comprend des projections pour 1980. Nous avons essayé de comparer les résultats du modèle, avec ces prévisions chiffrées d'une part, et avec les politiques préconisées dans le Plan d'autre part.

Résultats quantitatifs :

Production de viande :

Bien que le Plan et le modèle prévoient tous les deux un déficit croissant entre production et consommation de viande, la taille de ce déficit varie dans les deux cas.

Production de viande

Unités : Tonnes de carcasse + abats

	1970	(1972)	1975	1980	1985	1990
Plan	5,400	(5,900)	6,500	9,500	-	-
Modèle	-	(4,240)	9,670	12,390	22,490	50,570

Pour 1972, les résultats du modèle sont inférieurs aux chiffres du Plan. Ceci pourrait indiquer que, dans le modèle, nous avions sous-estimé la quantité de viande que chaque animal peut produire. D'autre part, l'accroissement plus rapide de la production de viande dans le modèle que dans le Plan est relié à l'important accroissement de la taille du troupeau ivoirien prévu par le modèle.

Bovins : nombre de têtes

	1970	(1972)	1975	1980	1985	1990
Plan: N'dama	355,000	(380,000)	416,000	506,000	-	-
Zébu	53,000	(56,600)	62,000	76,000	-	-
Total	408,000	(436,600)	478,000	582,000	-	-
Modèle: N'dama		369,300	471,300	693,200	1,247,200	2,953,200
Zébu		61,300	60,700	56,200	64,900	72,300
Total		430,600	532,000	749,400	1,312,100	3,025,500

D'après le modèle, cet accroissement de la taille du troupeau devrait être plus important que le Plan ne le prévoit. En particulier, ce taux de croissance est spécialement élevé après 1980 du fait que l'élevage de la race N'dama devrait de plus en plus s'effectuer en technique irriguée. Puisque les paramètres démographiques (survie et fécondité) sont bien meilleurs dans cette technique, ceci permet un accroissement rapide de la taille du troupeau. A cet égard, la différence entre les prévisions du Plan et les résultats du modèle peut suggérer que les paramètres démographiques

retenus dans le modèle sont en fait sur-estimés, particulièrement pour la technique irriguée. Nous reviendrons sur ces résultats dans la deuxième Partie.

Résultats qualitatifs :

En ce qui concerne les techniques d'élevage et d'embouche, certains résultats du modèle diffèrent des indications du Plan. Bien que celui-ci ne donne pas de répartition du troupeau entre les différentes techniques, il envisage la promotion de certaines activités . Nous allons maintenant comparer ces politiques proposées avec les résultats du modèle. Celui-ci ne choisit jamais la technique "améliorée" pas plus dans le cas des N'damas que dans celui des Zébus. Grâce à des dépenses supplémentaires, cette technique devrait entraîner une amélioration des caractéristiques du bétail (démographie et poids). Les résultats du modèle indiqueraient donc que le gain de productivité ne compense pas l'accroissement des coûts.

Cette conclusion est contraire à la politique proposée par le Plan, à savoir la promotion de cette technique "améliorée" parmi les fermiers. Cependant, les coefficients correspondants dans le modèle devront être contrôlés soigneusement avec l'administration ivoirienne avant qu'aucune conclusion ne puisse être tirée.

L'élevage en ranches de bétail N'dama n'apparaît pas non plus être une technique intéressante pour le modèle. Ce résultat est contraire à la politique officielle poursuivie en Côte-d'Ivoire comme dans d'autres pays africains, à savoir le mise en place de ranches. A l'opposé, le modèle donne à la technique irriguée un rôle particulièrement important aussi bien pour les N'damas que pour les Zébus. Ce résultat aussi apparaît surprenant puisque cette possibilité est pratiquement négligée et n'est envisagée qu'au stade de la recherche.Du fait de l'importance du sujet, nous y reviendrons dans notre deuxième Partie.

Bétail - Variante de base

Valeur en billions de CFA Surfaces en milliers d'hectares

		1972	1975	1980	1985	1990
	Production					
(1)	Valeur totale de viande et poisson	19.97	22.74	32.49	46.17	63.17
(2)	(dont imports)	5.59	5.91	8.04	10.31	12.13
(3)	Augmentation annuelle en valeur du troupeau	.36	.44	.71	1.74	5.52
(4)	Production totale (1) + (3)	20.33	23.18	33.20	47.91	68.69
	Consommations intermédiaires et emploi					
(5)	Consommations intermédiaires	6.65	8.66	13.11	21.58	38.68
(6)	Salaires	3.98	5.08	7.62	11.30	17.97
(7)	Nombre d'emplois non qualifiés	12,120	16,610	26,190	37,150	61,620
	Terre utilisée pour l'élevage					
(8)	Traditionnelle	3,195.	3,370.	4,000.	4,000.	4,000.
(9)	Jachère à stylosanthes	.6	11.7	33.0	40.0	46.0
(10)	Ranches	16.4	32.8	32.8	32.8	32.8
(11)	Irriguée	-	1.0	8.0	44.0	155.0
	Stock de capital					
(12)	Habitat	6.04	7.36	20.96	64.32	177.88
(13)	Machines	1.70	2.10	3.05	4.49	6.34
(14)	Véhicules	.26	.37	.63	1.14	2.42
(15)	Terres aménagées	.06	.37	1.70	4.99	13.28
(16)	Valeur du troupeau	6.48	7.70	11.22	19.90	47.52
(17)	Total du capital (12) + (13) + (14) +(15) + (16)	14.54	17.90	37.56	94.84	247.94
(18)	Amortissement annuel du capital	.52	.75	1.48	3.89	10.06
(19)	Valeur ajoutée brute de l'élevage et la commercialisation (4) - (2) - (5)	8.09	8.61	12.05	16.02	17.88
(20)	Valeur ajoutée nette (19) - (18)	7.57	7.86	10.57	12.13	7.82

Bétail - Variante de base - Consommation de viande et poisson

Unité : tonne de viande et
tonne de poisson équivalent frais

	1972	1975	1980	1985	1990
Consommation de boeuf	46,800	51,800	73,500	102,100	143,400
Produit localement, en technique traditionnelle	(4,120)	(7,070)	(11,110)	(12,850)	(12,610)
produit localement, en technique moderne	(120)	(980)	(1,390)	(9,640)	(37,630)
importé	(42,560)	(43,750)	(61,000)	(79,610)	(93,160)
Consommation de poulet	11,400	12,600	15,800	19,600	24,400
produit localement, en technique traditionnelle	(5,850)	(6,000)	(6,150)	(6,200)	(6,250)
produit localement, en technique moderne	(4,000)	(6,600)	(9,650)	(13,400)	(18,150)
importé	(1,550)	-	-	-	-
Consommation de mouton et chèvre	11,900	13,200	15,200	17,100	19,500
produit localement	(5,250)	(5,350)	(5,460)	(5,520)	(5,590)
importé	(6,650)	(7,850)	(9,740)	(11,580)	(13,910)
Consommation de porc	2,600	2,900	3,500	4,100	4,900
produit localement, en technique traditionnelle	(1,560)	(1,600)	(1,630)	(1,650)	(1,660)
produit localement, en technique moderne	(1,040)	(1,300)	(1,870)	(2,450)	(3,240)
importé	-	-	-	-	-
Consommation de poisson	116,000	137,000	187,000	260,000	353,000
pêché localement, en technique traditionnelle	(24,000)	(25,000)	(26,000)	(27,000)	(28,000)
pêché localement, en technique moderne	(67,000)	(102,000)	(161,000)	(233,000)	(325,000)
importé	(25,000)	(10,000)	-	-	-

Partie II : Les autres variantes étudiées

Certains des résultats de la variante de base paraissent inattendus. C'est le cas de l'importance donnée aux techniques d'élevage traditionnelles et irriguées. De même, il paraît surprenant que la technique du ranch n'ait pas été choisie.

Afin de juger de la plausibilité de ces résultats, il paraissait souhaitable de déterminer dans quelle mesure la solution obtenue dépendait des coefficients retenus dans le modèle. Pour ce faire, des hypothèses alternatives ont été essayées. Ce sont leurs résultats que nous présentons maintenant.

1. Hypothèse alternative du coût pour le ranch et la technique irriguée

Les coûts de capital et de fonctionnement de ces deux techniques peuvent être de manière commode exprimés en termes d'investissement ou de consommation par hectare. Ce coût par hectare est relié au coût par kg de bétail élevé au moyen d'un coefficient : la "charge". Ce coefficient est le nombre d'UBT (unité de bétail traditionnel correspondant à un poids vif de 250 kg). Cette charge varie bien entendu avec la technique d'élevage, la qualité de la terre, etc... Dans la variante de base, nous avions retenu les hypothèses suivantes, telles qu'elles nous avaient été données en Côte-d'Ivoire :

Il y a 4 qualités de terre pour le ranch, chaque qualité étant en disponibilité limitée. Un hectare de chaque qualité peut respectivement supporter :

1/4 d'U.B.T. par hectare pour la 1ère qualité

1/6 d'U.B.T. par hectare pour la 2ème qualité

1/8 d'U.B.T. par hectare pour la 3ème qualité

1/10 d'U.B.T. par hectare pour la 4ème qualité

En outre, nous avons considéré une seule qualité de terre pour l'irrigation. Un hectare de cette terre peut supporter 15 U.B.T. par hectare.

Comme ces coefficients n'étaient pas entièrement sûrs, nous avons retenu les hypothèses suivantes pour une variante alternative. Pour le ranch :

1 U.B.T. par hectare pour la 1ère qualité

1/2 d'U.B.T. par hectare pour la 2ème qualité

1/8 d'U.B.T. par hectare pour la 3ème qualité (pas de changement)

1/10 d'U.B.T. par hectare pour la 4ème qualité (pas de changement)

Pour la technique irriguée :

8 U.B.T. par hectare.

Avec ces hypothèses alternatives sur le nombre d'U.B.T. par hectare, la solution du modèle diffère de la précédente.

La technique traditionnelle apparaît encore comme la plus intéressante et est choisie avant les autres. Toutefois, lorsque les disponibilités en terre pour la technique traditionnelle sont épuisées, le relais est pris par la technique du ranch utilisant la première qualité de terre - au lieu de la technique irriguée. Comme ce type de terre est en quantité limitée, ce type d'élevage ne peut pas se poursuivre indéfiniment. Effectivement, les disponibilités en terre sont complètement utilisées avant 1985. A partir de là, la technique irriguée est utilisée et la technique du ranch employant la terre de deuxième qualité n'est jamais mise en oeuvre.

En conséquence, avec ces hypothèses alternatives, le ranch semble être plus intéressant que l'élevage de bétail sur pâturages irrigués. Toutefois, ceci n'est apparemment vrai que pour les ranches utilisant la meilleure qualité de terre.

C'est pourquoi il semble souhaitable d'améliorer nos coefficients techniques concernant le ranch et la technique irriguée avant de pouvoir décider laquelle est en fait la plus intéressante. Les résultats de la variante présentée ici semblent indiquer que le ranch pourrait être plus intéressant que la technique irriguée. Mais en tous les cas, la capacité d'élevage des seuls ranches n'est pas suffisante du fait des disponibilités limitées en terre pour les ranches. C'est pourquoi l'élevage sur pâturages irrigués devrait être mis en oeuvre au cours de la période 1970-1990. La variante suivante présentée ci-dessous indique aussi que, à la fois ranches et pâturages irrigués devraient être mis en oeuvre dans les deux prochaines décades.

2. Limite sur la quantité de terre disponible pour l'irrigation

La variante principale présentée dans la partie I souligne l'importance de l'élevage sur pâturages irrigués. Cette importance demeure avec des hypothèses alternatives quant à la capacité de "charge" par hectare ainsi que nous l'avons vu dans la section précédente (II,1.).

L'importance de l'irrigation soulève la question des disponibilités en terre. La variante de base déjà présentée demanderait environ 155.000 hectares de pâturages irrigués en 1990. La variante précédente (II,1.) demande une surface encore plus importante puisque la "charge" par hectare irrigué est moindre que dans la variante de base (8 U.B.T. par hectare au lieu de 25). Ceci indique qu'il pourrait y avoir un manque de terre disponible pour l'irrigation, même si des ranches étaient mis en place comme technique alternative. En conséquence, nous avons essayé une variante avec une quantité limitée de terre disponible pour l'irrigation. Dans cette variante, les "charges" par hectare retenues pour ranches et pâturages

irrigués sont les mêmes que dans la variante de base (partie I). La disponibilité en terre pour l'irrigation a été fixée à 50.000 hectares.

Notre premier résultat fût que la solution était impossible. Ceci signifiait qu'avec les limites retenues pour chaque type de terre (pâturages traditionnels aussi bien que ranches et pâturages irrigués), la disponibilité en terre était insuffisante pour accommoder la totalité du troupeau en 1990.

Puisqu'une "soupape de sécurité" était nécessaire, nous avons supprimé la limite sur la quantité de terre disponible pour les ranches. Bien qu'absurde le résultat obtenu est intéressant : pour accommoder l'ensemble du troupeau ivoirien en 1990, il faudrait consacrer 15 millions d'hectares de terre aux ranches.

Ceci indique que la mise en place de ranches ne peut, au mieux, qu'être un soulagement temporaire. Du fait de la disponibilité limitée en terre, l'accroissement de la taille du troupeau ivoirien nécessitera l'utilisation de techniques intensives économisant la terre comme c'est le cas de l'élevage sur pâturages irrigués.

La mise en oeuvre de cette technique intensive est d'autant plus nécessaire que cette utilisation de technique moderne (ranches et/ou irrigation) devrait accroître la taille du troupeau de manière très importante. En améliorant les coefficients de survie et fécondité du troupeau, la mise en oeuvre de ces techniques augmente le taux de croissance du cheptel et augmente aussi, en conséquence, la demande de terre. De ce fait, le besoin de techniques économisant la terre se trouve renforcé. Cette influence des techniques d'élevage moderne sur la taille du cheptel sera explicitée dans la variante suivante.

3. Suppression de la contrainte sur les pâturages traditionnels

Dans notre variante de base comme dans les deux suivantes, nous avons supposé que la surface de terre consacrée à l'élevage de type traditionnel et amélioré était limitée à 4 million d'hectares. L'existence même de cette contrainte exige la mise en oeuvre de techniques plus modernes permettant d'économiser la terre. Toutefois, le niveau exact de cette limite est inconnu et en conséquence il est difficile de préciser dans quelle mesure il est urgent de mettre en place ces nouvelles techniques.

Comme hypothèse extrême nous avons testé le cas où aucune limite sur les pâturages traditionnels n'existerait. Bien qu'irréaliste ce cas permet de souligner certaines caractéristiques de la technique d'élevage traditionnel, qui l'opposent aux techniques modernes :

Premièrement, la surface totale de terre exigée par la technique traditionnelle serait de l'ordre de 9,3 millions d'hectares. Comme ce chiffre est supérieur à la plus haute estimation de la surface de terre disponible pour l'élevage traditionnel, ceci indique la nécessité de mettre en oeuvre des techniques plus intensives avant 1990.

Deuxièmement, le nombre de têtes de bétail en 1990 est, dans cette variante, bien inférieur au nombre correspondant de la variante principale : 1,6 millions aulieu de 3 millions. Cet écart est dû à la différence des coefficients démographiques entre les techniques traditionnelles et irriguées. Pour mettre en évidence cette différence, nous pouvons comparer les coefficients de reproduction d'une vache N'dama dans la technique traditionnelle et la technique irriguée. Au cours de sa vie, une vache donnera naissance à un certain nombre de veaux et génisses. Seule une certaine proportion de ces jeunes génisses survivra assez longtemps pour atteindre la maturité

c'est-à-dire l'âge auquel elles peuvent à leur tour donner naissance à leur premier veau. Nous définissons comme coefficient de reproduction ce dernier nombre. Par exemple, une vache N'dama élevée en technique traditionnelle devrait, au cours de sa vie, donner naissance à 1,7 génisses qui survivront assez longtemps pour avoir leurs propres veaux. Le coefficient correspondant pour la technique irriguée serait de 3,3.

Troisièmement, le schéma d'embouche de cette variante diffère du schéma que nous obtenions dans la variante de base (c'est-à-dire la variante où nous avions retenu une limite sur la surface de pâturages traditionnels). L'embouche sur jachère n'est pas sélectionnée et l'embouche est limitée à la technique traditionnelle. De plus, la durée de cette embouche n'est plus limitée uniquement à un an comme dans la variante de base. De fait, l'embouche de veaux Zébus en technique traditionnelle apparaît plus intéressante si elle dure deux ou trois ans au lieu de un an - c'est-à-dire si les veaux sont abattus quand ils ont 3 ou 4 ans au lieu de deux ans.

Ce résultat provient bien sûr du fait que puisque la terre n'est plus une ressource limitée, elle peut être plus largement utilisée.

En résumé, le principal intérêt de cette variante est de souligner le fait que la mise en oeuvre de techniques intensives économisant la terre ne peut être évitée, puisque la terre deviendra une ressource rare avant 1990. En outre, il met en évidence le fait que cette mise en oeuvre nécessaire des techniques modernes amènera un accroissement important de la taille du troupeau.

Partie III : Etude du projet - Le cas du ranch

Dans cette partie, nous essayons de mettre en évidence quelle pourrait être la contribution de ce type de modèle à l'étude économique d'un projet particulier. Puisque le critère le plus largement utilisé pour l'étude d'un projet est le taux de rendement interne, nous comparerons cette méthode avec une utilisation possible du modèle. A cet égard, deux principales utilisations du modèle peuvent être envisagées. Nous pouvons, ou bien insérer dans le modèle le projet considéré ou estimer à partir du modèle des prix comptables qui seront utilisés dans un calcul "classique" du taux de rendement interne.

1. Utilisation directe du modèle

Si un projet de ranch particulier était étudié, ses données techniques pourraient être utilisées pour définir les coefficients d'une "activité" ou colonne du modèle. Cette colonne aura alors la même fonction que les quatre activités déjà existantes correspondant aux quatre qualités de terre.

Avec cette utilisation, le projet ne sera pas étudié seul mais en correspondance avec les activités d'élevage alternatives.Non seulement, les techniques de ranches mais les autres techniques aussi bien pourront alors concurrencer ce projet particulier pour l'utilisation des ressources rares.

En conséquence, la rentabilité économique dépendra alors des caractéristiques de ces techniques alternatives. Pour illuster ce point, nous pourront nous référer aux variantes étudiées dans les deux parties précédentes.

Les coefficients techniques de l'activité du ranch utilisant la première qualité de terre (colonne F1lF) ont été calculés à partir d'un projet effectivement envisagé. En conséquence, nous pouvons considérer que cette

activité représente un projet spécifique dont nous voulons estimer la rentabilité économique. Le résultat obtenu est que cette rentabilité dépend non seulement des paramètres du projet proprement dit mais des caractéristiques des techniques alternatives. Puisque ces caractéristiques ne sont pas précisément connues maintenant, nous avons dû essayer différentes hypothèses. Le résultat indique qu'une amélioration des données utilisées est nécessaire avant que nous puissions pleinement juger de la rentabilité économique d'un tel projet. Par exemple, si nous retenions les coefficients obtenus en Côte-d'Ivoire et supposions qu'il n'existe pas de limite sur les disponibilités en terre pour l'irrigation, le projet de ranch envisagé n'apparaît pas économiquement rentable avec un taux d'actualisation de 10 %. Pour être plus précis, ce projet paraît moins intéressant qu'un projet alternatif d'élevage sur pâturages irrigués (variante de base, partie I). Au contraire, si nous supposons que la charge par hectare est mesurée plus exactement par les chiffres retenus dans la variante (Partie II, section 1), le résultat est différent. Le projet de ranch apparaît alors être économiquement rentable. Ce même résultat est vrai si la surface de terre disponible pour l'irrigation est limitée à 50.000 hectares (Partie II, section 2).

Dans ce dernier cas, un calcul direct du taux de rentabilité interne aurait indiqué que le ranch était moins intéressant qu'un projet sur pâturages irrigués. L'utilisation du modèle montre en fait que ce projet est économiquement rentable du fait des disponibilités limitées en terre propre à l'irrigation.

En conclusion, nous pouvons dire qu'une amélioration de certaines données est nécessaire avant que nous puissions conclure quant à la rentabilité économique d'un projet quel qu'il soit. Lorsque des informations plus

précises concernant la disponibilité en terre et la "charge" par hectare des techniques alternatives seront obtenues, nous serons capable d'estimer la rentabilité économique d'un projet d'élevage quel qu'il soit en le comparant à des techniques d'élevage alternatives.

Si des données suffisamment précises ne peuvent être obtenues, il devrait être possible à tout le moins de réduire l'intervalle de plausibilité pour ces paramètres particulièrement sensibles. Alors la résolution du modèle, successivement pour la plus haute et la plus basse valeurs possibles pour ces paramètres, devrait montrer ce qu'il advient de la rentabilité économique du projet dans les cas les plus extrêmes. Ces différents résultats devraient, dans tous les cas, améliorer l'information concernant le projet et, par là, faciliter la prise d'une décision.

2. Estimation des prix comptables

Des prix duaux pour les ressources rares apparaissent comme le résultat annexe de tout modèle de programmation linéaire. Dans le cas de notre modèle, la terre paraît être un tel bien disponible en quantité limitée. C'est pourquoi il est intéressant d'obtenir une idée du prix auquel la terre devrait être comptée dans toute estimation d'un projet d'élevage. Pour les mêmes raisons avancées dans la section précédente, ce prix comptable dépendra des techniques alternatives possibles et des disponibilités pour ces ressources rares. Pour prendre les cas les plus extrêmes, le prix comptable d'un hectare de terre pour un projet de ranch variera de zéro (si la disponibilité en terre pour la technique d'élevage sur pâturages irrigués est illimitée) jusqu'à 375.000 francs CFA (si cette disponibilité est limitée à 50.000 hectares). Il est particulièrement frappant de constater qu'il est nécessaire de connaître les disponibilités en terre propre à l'irrigation afin de déterminer le prix comptable de la terre utilisable pour les ranches.

Une fois de plus, le modèle montre la relation entre les différentes techniques qui ne peuvent être estimées séparément. Une amélioration nécessaire des données devrait fournir une meilleure estimation des prix comptables.

Partie IV : Résumé et conclusion

Bien que l'on puisse en obtenir d'utiles indications, les présents résultats du modèle comportent certaines limitations. Nous allons insister sur celles-ci avant d'essayer de résumer ce qui paraît être les apports les plus importants du modèle.

Les résultats obtenus doivent être utilisés avec beaucoup de précautions, du fait de l'incertitude pesant sur les données utilisées. En particulier, les aspects qualitatifs des résultats paraissent plus importants que leurs valeurs chiffrées. Par exemple, on devrait accorder plus d'attention aux techniques d'élevage et d'embouche sélectionnées par le modèle plutôt qu'à la valeur exacte de ces activités. Cette précaution est particulièrement importante pour les années les plus éloignées de notre période. Bien que nous puissions regarder avec défiance le niveau atteint par la technique d'élevage sur pâturages irrigués en 1990, l'utilité et l'importance de cette technique n'en demeurent pas moins vraies.

La partie du modèle concernant le petit élevage et la pêche a été essentiellement prise en compte pour mettre en évidence une extension possible d'une telle étude. Toutefois, ces résultats devraient être considérés avec énormément de précautions jusqu'à ce que les données incluses dans le modèle aient été améliorées.

Cette amélioration dans les données est nécessaire pour l'ensemble du modèle si nous voulons obtenir des informations plus sûres concernant, par exemple, la rentabilité respective du ranch et de l'élevage sur pâturages irrigués ou l'intérêt économique d'un projet d'élevage quel qu'il soit.

Mais quelles que soient les limitations actuelles du modèle, des informations intéressantes peuvent déjà être obtenues de ces résultats.

La plus importante semble être que la Côte-d'Ivoire pourrait faire face à un manque de terre pour l'élevage dans les prochaines décades. Cette limite dans les disponibilités entraînera la nécessité de mettre en place des techniques d'élevage intensives permettant d'économiser la terre. Il devrait être aussi utile de réduire la durée de l'embouche; l'âge optimal pour l'embouche des veaux paraîssant être aux environs de deux ans.

Si nous voulons préciser les indications données dans le modèle, l'image suivante de l'élevage en Côte-d'Ivoire semble se dégager pour la fin des années 80 :

Le secteur "traditionnel" devrait augmenter à la limite des disponibilités en terre. La part des Zébus dans ce troupeau traditionnel pourrait augmenter aussi puisque cette race semble mieux adaptée aux techniques traditionnelles. Toutefois, la vulnérabilité de cette race à la trypanosomiases doit être prise en compte pour nuancer la proposition précédente. A côté de l'élevage des vaches en pâturages traditionnels, l'embouche des veaux sur jachère à stylosanthes paraît être une activité intéressante. Dans ce cas les veaux devraient être abattus quand ils ont environ deux ans.

Le secteur "moderne" (ranch et technique irriguée) deviendra de plus en plus important. Il concernerait principalement la race N'dama qui apparaît plus prometteuse. Ce secteur pourrait assurer l'élevage des vaches et l'embouche des veaux jusqu'à un âge optimal qui paraît aussi être aux environs de 2 ans. En outre, ce secteur moderne pourrait augmenter sa capacité en achetant des génisses de fermiers traditionnels. Toutefois, il ne paraît pas économiquement intéressant d'acheter des veaux du secteur traditionnel pour les emboucher dans des techniques modernes.

Les capacités productives du ranch et de l'élevage sur pâturages irrigués sont limitées puisque les disponibilités en terre pour chacun d'eux sont limitées. C'est pourquoi les deux techniques devront être mises en oeuvre au cours de la période : il paraît alors relativement moins important de savoir laquelle des deux est la plus rentable.

Puisque l'élevage sur pâturages irrigués est relativement moins bien connu maintenant, il semble rationnel de commencer par mettre en place un élevage en ranches. Il apparaît toutefois nécessaire, tout au moins à long terme, de faire appel à des techniques intensives comme l'élevage sur pâturages irrigués.

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Ivory Coast Research Project

A SYSTEM OF PROGRAMMING MODELS FOR THE PRIMARY SECTOR OF THE IVORY COAST

Results of the Livestock Sector

This paper reports the results of the model studying the development of the Livestock-Fishing sector. This model is included in a model system studying the primary sector of the Ivory Coast. This study is part of the Research Project on Multi-Level Programming Studies with Application to the Ivory Coast.

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Rural Sectoral Model

Part I : Characteristics of the "Livestock" model

As part of the system of rural sectorial models, the livestock model shares with the other models (North, South and South-West sub-models) many characteristics already presented in the rural model papers. Therefore, only those features of the livestock model specific to this sub-sector will be investigated here. Besides all the technical presentation of this model (list of rows and columns, technical coefficients, equations) have been gathered in a special document available at the DRC.

1) General

The livestock model is dynamic, spanning from 1972 to 1990. As in the other models, the objective function to be maximized is the social value added of the period. This objective function is computed as the discounted sum of the social value added pertaining to each year between 1972 and 1990 . The problem of investment has been treated as in the other models. More specifically the handling of its value at the last year of the model is the same. However, the value of the cattle existing in 1990 raised a particular problem. The herd is measured within the model in terms of head of cattle and its value is not computed as is the case for investment. That is why some assumption had to be made concerning the prices of the animals in 1990 . The present prices have been retained and the corresponding value of the herd

in 1990 has been added to the objective function in the same manner as the other investments.

In the model, the following types of animals - and meat - have been taken into account: bovines, ovines and caprines, porcines and poultry. Due to the lack of reliable data for fishery it has been deemed preferable to introduce only two techniques, however, more could be added if such data were obtained.

For each type of meat and each year of the model, a minimum level of demand has been estimated. This demand has to be fulfilled either by local production or imports for each type of meat. Besides this minimum demand by type, the model must also meet an increasing incremental demand for meat. In otherwords, this assumes that once a minimum level of consumption of each type of meat is secured, the consumers are able to switch their supplementary demand to different types of meat.

Due to the fact that it takes less than one year to raise sheep, goats, pigs or chickens, these types of activities are considered as annual in the model. However, the feeding and breeding of cows and calves are pluriannual activities.

2) The Feeding Techniques

As to the feeding and breeding of the bovines, a distinction is made between the two breeds - Zebus and N'damas - currently raised in the Ivory Coast. Zebus are presently less numerous : about 50,000 head of cattle. They are susceptible to trypanosomiases and can only be raised in the northern parts of the Ivory Coast. The N'dama breed

(approximately 330,000 head of cattle) is immuned to trypanosomiases and, therefore, appears to have a more promising future. Four feeding techniques have been considered:

- traditional: This technique represents the present method of raising cattle.

- improved: Assuming a minimum of medical expenses, mostly borne by the public administration, it is deemed feasible to improve the characteristics (survival, fecundity rate, and weight) of the herd raised by the farmers.

- ranch: Some experiments in the Ivory Coast as well as in other African countries have shown the profitability of raising cattle on modern ranches. We have introduced this activity in the model for the N'dama, the only breed involved in the Ivorian experiments.

- irrigated: Although it has never been attempted on a large scale in the Ivory Coast, the intensive feeding and breeding of cattle on irrigated fields seems to be promising. This activity is introduced into the model for the Zebus as well as the N'dama breed.

Based on the economic profitability of each of these basic techniques, cattle are going to be switched from one feeding technique to another. It has been assumed that, for the cows, the transfer will occur just before the heifers bear their calves, i.e. when the N'dama cow is a full three years old and a Zebu is four years old.

A cow transferred from one technique to another will not immediately adopt the characteristics of this final technique. As regards to the related coefficients - survival, fecundity, and weight - it has been assumed that the gap between the initial and the final

technique will gradually shrink to zero over a period of five years.

For these reasons a feeding activity (i.e. a column of the model) is defined both by an original technique - the one in which the cow was bred, and a final technique - the one to which it was transferred. If the original and the final techniques are the same the so-called transfer is fictitious.

3) The Initial Stock

Until now Ivory Coast farmers have raised their herds according to what we call the "traditional technique". Hopefully the efforts of the administration will improve that method. The expansion of medical services for cattle along with technical advice will allow a progressive transformation of this traditional technique into what we define as the "improved technique". Therefore, for the first years of the model the "transfer" of the cattle from the traditional to the improved sector will signify a spreading of this improved technique among farmers, rather than a physical transfer from a "traditional" farmer to one who uses the "improved" technique. In this case, the "transfer" will not concern the young cows only, but the farmer's total herd whatever their age. In a representative year of our model the economic entity -i.e. the unit of the feeding column with the models- is the young cow (3 years old for N'dama, 4 years old for Zebu), which can be transferred to a technique other than the one in which it was bred. The problem is different for the first years of our period, at least as far as the transfer from "traditional" to "improved" is concerned. We can no longer consider the young cow as a single unit but rather as a "repre-

sentative" cow standing for the whole of the herd. Therefore for the first years of the model some supplementary columns represent the whole of the cows - excluding the heifers - within the traditional stock. Some other columns have also been added to represent the whole of the cows within the "improved" stock. Transfers are allowed from the former columns - "traditional" stock - to the latter ones - "improved" stock. In fact, this "transfer" means an improvement in the farmer's technique without any actual transfer.

This traditional stock, as well as the improved stock into which it can be transferred, will gradually disappear due to natural mortality. It is further assumed that the offspring of these traditional or improved stocks can be freely transferred from one technique to another. As indicated in Section 2, the transfer will occur for the cows when they are 3 (N'dama) or 4 (Zebu) years old without any obligation of transferring the remainder of the herd in the same proportion. This assumes that, for these cows, there can be a physical transfer from a "traditional" farmer to an "improved" one.

4) The Breeding Techniques

In addition to the techniques considered for the feeding, another technique was chosen for the breeding. This is the opportunity for small farmers to raise calves of both breeds on fallow with stylosanthes. After its birth, a calf stays at least some months with its mother within the same technique. It can then be bred in another manner and consequently be transferred from the initial feeding technique to another. It is theoretically possible for a calf to be transferred

many times during its breeding period. However, it has been assumed as a rule that each calf would be transferred only once. Only a few cases of double transfer (one year in the "improved" or "fallow" technique followed by a transfer to the irrigated technique) have been retained.

Thus the following simplifying assumption has been adopted. It is determined that a calf may stay in the technique where it was born until it is one, two, or three years old and then be transferred to another breeding technique for one year before it is slain; or a calf may stay in the same technique without any actual transfer. In this latter case the transfer would only be fictitious. Just as for the cows, a transferred calf will not adopt the characteristics pertaining to the new technique at once, but in contrast to the cows, only a one year lag has been assumed before the calves acquire these characteristics.

5) Transfer

In the above paragraphs it has been shown that transfers were possible between the different activities - feeding, raising of the initial stock, and breeding. The transfer can either be actual or fictitious.

The first case -actual transfer- occurs when one animal (calf or cow) is in fact physically transferred from one owner to another. The second case -fictitious transfer- occurs when the animal remains with its original owner.

A fictitious transfer is obviously costless whereas a physical transfer entails some expense, mainly due to medical costs. These

expenses vary according to the original and final techniques involved in the transfer. However, we assume that these expenses are the same for all techniques. The only exceptions are a transfer from the ranch technique (the cost of transfer is already included in the overall cost), and a transfer from the traditional to the improved technique, in which case we assume that the expenses are negligible.

6) Slaughterhouse and Commercialization

Due to a lack of reliable data, the process of slaying and marketing has been inserted into the model in a simplified form. Within the raising industry the distinction has been made between a modern sector (the ranch and irrigated raising techniques) and a conventional sector (including the traditional, improved, and fallow raising techniques). The production of these two different sectors will go through different channels of marketing, transportation and slaughtering. For instance, the cattle raised in the modern sector are more likely to be carried on trucks, slain in modern slaughterhouses, and consumed in big cities than the cattle raised in the conventional sector.

Therefore, the costs of slaying and marketing for these two sectors are different even though the final output (the ton of meat for immediate consumption) is considered to be the same.

7) Small farm animals, poultry, and fish

These animals have always been raised in the Ivory Coast in a traditional manner, but during the last few years more modern techniques (traditional and modern) of raising such animals have been

implemented. Therefore two competitive techniques (traditional and modern) of raising such animals have been introduced into the model. For ovines and caprines, only the traditional technique has been considered. The results of this part of the model have to be dealt with carefully since most of the data used is not reliable. In particular, it is difficult to assess the actual costs of the traditional raising techniques although these costs are certainly low and these activities are profitable. This does not imply that these activites may be developed without any restriction. There is certainly a limit to their potential extension even though this limit cannot be easily assessed. As a working hypothesis, we have assumed that these activities could not grow faster than the rural population during the model period

In the fishing activity, we made the distinction between a traditional and a modern technique. These two techniques are, of course, annual activities. Besides, the level of the traditional technique for fishing has been limited in the same way as the traditional technique for small farm animals and poultry.

Part II: The results of the main alternative:

In this and the following sections as well, we are going to designate as the main alternative the version built with the set of data collected in the Ivory Coast. The results of this main alternative have been checked and analyzed in order to define some other alternatives. These are defined according to changes in certain coefficients which appeared to be sensitive and/or unreliable. We shall first present the results of the main alternative before comparing them to the forecasts of the Ivorian Five-Year Plan.

1. The results

The main results of this basic alternative are shown in two tables at the end of this part.

(a) Small cattle raising and fishing activities

We shall first consider the results concerning small cattle and the fishing activities. Due to the unreliability of the data, these results should not be entirely trusted as long as the coefficients have not been thoroughly checked.

Due to their low costs, the traditional techniques of raising poultry, ovines, caprines, and porcines are, of course, the most profitable. Consequently, they were fully utilized in the model. But as we set some upper limits to these traditional activities, the production of meat is taken over by the modern techniques in the case of poultry and porcines and by importation in the case of ovines and caprines.

In the first paragraph of Part I, we explained how we set in the model a so-called "increasing incremental demand" for meat. This exceeding demand for meat could be matched by any of the cattle raising techniques. However, the model chose poultry raising to meet this excess demand which simply confirms the fact that chicken meat can be produced at a lower cost. Similarly, for the fishing activities, the traditional way appears to be the cheapest followed by the modern technique which seems to be more profitable than importation.

(b) Bovine raising

The most important results are the following:

- production of meat: The present shortage of beef meat production -- as related to consumption -- should persist in the coming years. However, the relative size of this deficit should decrease.

Quantities of meat expressed in tons of carcass + offals

	1972	1975	1980	1985	1990
Consumption	46,806	51,800	73,500	102,100	143,400
Production	4,240	9,610	12,390	22,490	50,510
Consumption/(%) production	9%	18.5%	17%	22%	35%

- feeding and breeding techniques. Surprisingly enough, the most profitable technique, for feeding and breeding as well, seems to be the traditional one. This is, of course, due to its low costs which more than compensate for its low returns -- in terms of the weight of the animals.

Insofar as more expenses are entailed the improved technique seems to be less profitable than the traditional and the model rejects it. Since the traditional raising technique is land consuming -- and the supply of land limited -- the expansion of this technique cannot be pursued indefinitely. We have assumed that 4 million hectares were available for this purpose. Due to the increase of the size of the traditional herd, this limit should be reached before 1980 after which it will be necessary to switch to more intensive techniques. Then the pattern is basically different between the two breeds of cattle (N'dama and Zebu) despite some similarities.

According to the model, it should be more profitable to continue the feeding of zebus in the traditional way. Since the supply of land for this traditional raising technique is limited, the expansion of the zebu cattle will go on at the expense of the N'damas. In fact, the feeding of N'damas relies more and more over the years on the irrigated technique.

As regards the ranch technique, it does not seem to be profitable with the coefficients assumed in this alternative. In fact the ranch technique appears in the model only because it was forced to by a constraint aimed at accounting for the initial ranch herd in 1972.

The breeding techniques selected by the model differ according to the breed and the initial feeding techniques. However, these breeding techniques present some common characteristics:

The double-transfer technique (1 year in improved or fallow technique preceding 1 or 2 years in the irrigated technique) never come out. This indicates that these techniques appear to be less profitable than the chosen single transfer techniques.

As for the single-transfer techniques selected by the model, the last of the breeding period never exceeds one year. In other words, the calves are slain when they are two years old and it never seems to be profitable to breed them until they are 3 or 4 years old.

In order to further present the breeding techniques, we have to distinguish between the two breeds and among the feeding techniques from whence the calves come.

N'dama breed:

The calves coming from the traditional feeding technique will be bred in the traditional way as long as there is available land. Once the land constraint is reached, the breeding process is taken over by the fallow technique which is less land-consuming. Similarly, the calves born on ranches are bred on fallow too. Finally, the calves born on irrigated fields will be bred in this same irrigated technique.

Zebu breed:

The situation is very similar to the N'dama case. However, all the Zebu calves come from the traditional technique as this technique

accounts for the total feeding of the Zebu cattle. Like the N'dama breed, the Zebu calves born in a traditional herd will be bred with this technique as long as there is land available, namely between 1975 and 1980. Afterwards the fallow technique takes over the breeding process. The calves are then transferred from the traditional technique where they were born to a fallow where they are bred for one year.

These changes in the pattern of feeding and breeding have the following results on the size of the herd:

Unit: Head of Cattle — Basic Alternative

	1972	1975	1980	1985	1990
N'dama herd raised:					
In the traditional way	363,240	436,630	483,430	464,570	456,420
In the improved way	-	-	-	-	-
On ranches	3,560	6,380	7,780	7,340	7,776
On fallow with stylosanthes	1,460	24,200	71,880	78,610	84,360
On irrigated fields	1,100	4,090	130,130	696,680	2,404,650
Sub-total N'dama	369,360	471,300	693,220	1,247,200	2,953,190
Zebu herd raised:					
In the traditional way	61,160	57,830	53,750	61,350	67,900
In the improved way	-	-	-	-	-
On fallow with stylosanthes	100	2,860	2,390	3,510	4,400
On irrigated fields	-	-	-	-	-
Sub-total Zebu*	61,260	60,690	56,140	64,860	72,300
Total cattle	430,620	531,990	749,360	1,312,060	3,025,490

*The apparently paradoxical pattern of growth of the Zebu cattle -- first decreasing and then increasing over the years -- is due to the fact that in 1972 an important part of the herd is made up by calves (almost 8,000). These calves are all slain in or before 1975; thus, the decrease in the size of the herd.

The growth rate of the Ivorian herd changes drastically around 1980. This is due to the switch in the raising techniques which should occur at that time. With the possibilities of further exploitation of the traditional technique coming to an end, modern land-saving techniques must then take the lead. Since these latter techniques entail an important improvement in the demographic parameters of the cattle, it ensures a dramatic increase in the size of the herd. This question is further discussed in the next section, and in Part III, section 3.

2. Comparison with the Ivorian Plan:

The Ivorian Plan for 1971-1975 includes some forecasts for 1980. We have tried to compare the results of the model with these figures as well as with the policies advocated in the Plan.

Quantitative results:

Production of meat:

Although both the Plan and the model foresee an increasing deficit between production and consumption of meat, the size of this deficit varies in the two cases.

Production of meat

Units: tons of carcass + offals

	1970	(1972)	1975	1980	1985	1990
Plan	5,400	(5,900)	6,500	9,500	-	-
Model	-	(4,240)	9,670	12,390	22,490	50,570

For 1972, the results of the model are inferior to the forecasts of the plan. This could indicate that within the model we have underestimated the quantity of meat that each animal can produce. On the

other hand, the faster increase of the meat production in the model vis-a-vis the Plan is related to the sharp increase in the total size of the Ivorian herd foreseen in the model

Bovine cattle: number of heads

	1970	(1972)	1975	1980	1985	1990
Plan N'dama	355,000	(380,000)	476,000	506,000	-	-
Zebu	53,000	(56,600)	62,000	76,000	-	-
Total	408,000	(436,600)	478,000	582,000	-	-
Model N'dama		370,300	457,300	693,200	1,247,200	2,951,200
Zebu		61,300	60,700	56,200	64,900	72,300
Total		431,600	512,000	749,400	1,312,700	3,023,500

According to the model, the increase in the number of cattle is going to be more important than the Plan foresees. In particular this rate of increase is especially important after 1980 due to the fact that the feeding of the N'dama cattle will increasingly depend on the irrigated technique. Since the demographic parameters (survival and fecundity) are much better in this technique, it permits a rapid increase in the size of the herd. In this connection, the discrepancy between the forecasts of the Plan and the results of the model could be a hint that the demographic parameters of the cattle are in fact overestimated; in particular for the irrigated technique. We shall come back to these results in the third part of this document.

Qualitative results:

As far as the choice of the raising technique is concerned, many results of the model differ from the indications of the Plan. Although the Plan does not give any breakdown of the total number of cattle between the different techniques, it advocates the implementation of certain measures and techniques. We shall now have a look at these policies vis-a-vis the results of the model.

Neither for the N'dama nor for the Zebu does the model select the use of the so-called "improved" technique. This technique with some extra expenses would entail an improvement in the characteristics of the cattle (demography and weight). The result of the model would therefore indicate that the gain in productivity does not compensate for the increase in cost.

This conclusion is contrary to the policy propounded in the Plan, namely the promotion of this "improved" technique among the farmers. However, the related coefficients of the model should be carefully checked with the Ivorian administration before any final conclusion can be drawn.

The raising on ranches of N'dama cattles does not appear for the model to be a profitable technique. This is opposite to the policy officially pursued in Ivory Coast as well as in many other African countries, namely an increasing implementation of ranches. The model instead selects overwhelmingly, for both N'dama and Zebu, the irrigated technique. This too comes as a surprise since this opportunity is almost neglected in the Plan and is only considered at the research stage. Due to the importance of this subject, we shall come back to it in our third part.

Livestock - Basic Alternative

Value in billions of CFA Surfaces in thousands of ha.

		1972	1975	1980	1985	1990
	Production					
(1)	Total value of meat and fish	19.97	22.74	32.49	46.17	63.17
(2)	(of which imports)	5.59	5.91	8.04	10.31	12.13
(3)	Annual increase in value of herd	.36	.44	.71	1.74	5.52
(4)	Total production (1) + (3)	20.33	23.18	33.20	47.91	68.69
	Inputs and Labor force					
(5)	Inputs	6.65	8.66	13.11	21.58	38.68
(6)	Wages	3.98	5.08	7.62	11.30	17.97
(7)	Number of unskilled workers	12,120	16,610	26,190	37,150	61,620
	Land used by raising activities					
(8)	Traditional	3,195.	3,370.	4,000.	4,000.	4,000.
(9)	Fallow	.6	11.7	33.0	40.0	46.0
(10)	Ranches	16.4	32.8	32.8	32.8	32.8
(11)	Irrigated	-	1.0	8.0	44.0	155.0
	Capital Stock					
(12)	Housing	6.04	7.36	20.96	64.32	177.88
(13)	Machinery	1.70	2.10	3.05	4.49	6.84
(14)	Vehicles	.26	.37	.63	1.14	2.42
(15)	Upgraded land	.06	.37	1.70	4.99	13.28
(16)	Value of the herd	6.48	7.70	11.22	19.90	47.52
(17)	Total of capital (12) + (13) + (14) + (15) + (16)	14.54	17.90	37.56	94.84	247.94
(18)	Annual amortization of capital	.52	.75	1.48	3.89	10.06
(19)	Gross value added by raising and marketing activities (4) - (2) - (5)	8.09	8.61	12.05	16.02	17.88
(20)	Net value added (19) - (18)	7.57	7.86	10.57	12.13	7.82

apparently holds true only for the ranches using the best quality of

Livestock - Basic Alternative: Consumption of Meat and Fish

Units: ton of meat and ton of fish equivalent fresh

	1972	1975	1980	1985	1990
Consumption of beef	46,800	51,800	73,500	102,100	143,400
locally produced, traditional way	(4,120)	(7,070)	(11,110)	(12,850)	(12,610)
locally produced, modern way	(120)	(980)	(1,390)	(9,640)	(37,630)
imported	(42,560)	(43,750)	(61,000)	(79,610)	(93,160)
Consumption of chicken	11,400	12,600	15,800	19,600	24,400
locally produced, traditional way	(5,850)	(6,000)	(6,150)	(6,200)	(6,250)
locally produced, modern way	(4,000)	(6,600)	(9,650)	(13,400)	(18,150)
imported	(1,550)	-	-	-	-
Consumption of sheep and goat	11,900	13,200	15,200	17,100	19,500
locally produced	(5,250)	(5,350)	(5,460)	(5,520)	(5,590)
imported	(6,650)	(7,850)	(9,740)	(11,580)	(13,910)
Consumption of pork	2,600	2,900	3,500	4,100	4,900
locally produced, traditional way	(1,560)	(1,600)	(1,630)	(1,650)	(1,660)
locally produced, modern way	(1,040)	(1,300)	(1,870)	(2,450)	(3,240)
imported	-	-	-	-	-
Consumption of fish	116,000	137,000	187,000	260,000	353,000
locally caught, traditional way	(24,000)	(25,000)	(26,000)	(27,000)	(28,000)
locally caught, modern way	(67,000)	(102,000)	(161,000)	(233,000)	(325,000)
imported	(25,000)	(10,000)	-	-	-

land available for irrigation. In this alternative, the "charge" per hectare retained for both ranch and irrigated field are the same as in the main alternative (Part II). The supply of land for irrigation has been fixed at 50,000 hectares.

Our first result was that the solution was infeasible. This meant that, with the retained limits on every type of land ("normal" land as well as ranches and irrigated fields), the supply of land was insufficient to accommodate the total herd in 1990.

Since a "safety valve" had to be given, we eased the limit on the quantity of land available for ranching. The result is interesting albeit absurd: in order to accommodate the total Ivorian herd in 1990, there should be more than 15 million hectares of land devoted to ranches.

This would indicate that the implementation of ranches can at best be only a temporary relief. Due to the shortage of land, the increase in the size of the Ivorian herd has finally to depend on the use of intensive, land-saving techniques like irrigation.

The implementation of this land saving technique is all the more needed since the very implementation of modern raising techniques (ranches and/or irrigation) should increase drastically the size of the herd. By improving the survival and fecundity coefficient of the cattle, the use of these techniques increases the growth rate of the livestock and consequently the demand for land. Therefore the need of land saving techniques is further enforced. This influence of the modern raising techniques on the growth of the herd will be exemplified in the next alternative.

3. Easing of the constraint on traditional grazing

In our main alternative as in the two following ones, we have assumed that the surface of land devoted to the traditional and improved cattle raising techniques was limited to 4 million hectares. The very existence of this constraint requires the implementation of more modern, land-saving techniques. However, the exact level of this limit is unknown and therefore the urgency of switching to these new techniques cannot be precisely ascertained.

As an extreme assumption, we have tested out the case where no limit on "normal" land would exist. Although unrealistic, this case distinguished certain characteristics of the traditional raising technique vis-a-vis the modern ones:

Firstly, the total surface of land needed for the traditional technique would be some 9.3 million hectares. Since this figure is above the highest estimation of the surface of land available for the traditional raising activity, this indicates the necessity of switching to more intensive methods before 1990.

Secondly, the number of cattle in 1990 is, in this alternative, much lower than in the main one: 1.6 million versus 3 million. This difference is due to the difference of the demographic coefficients between the traditional and the irrigated techniques. To exemplify this difference between the coefficients, we can compare the reproduction coefficients of a N'dama cow in the traditional technique and in the irrigated technique. During its life span a cow will bear a certain number of calves or heifers. Only a certain proportion of these young

heifers will live long enough to reach maturity, i.e. the age when they can in turn bear their first calf. We define as the reproduction coefficient this latter number. For example a N'dama cow raised in the traditional technique should during its life give birth to 1.7 heifers which will survive long enough to have their own calves. The corresponding coefficient in the irrigated technique would be: 3.3.

Thirdly, the breeding pattern in this alternative differs from the pattern occuring in the main alternative, where we retained a limit on the surface of normal land. The breeding on fallow does not come out and the breeding is restricted to the traditional way. Moreover, the last of the breeding process is no longer always confined to one year as in the main alternative. In fact the breeding of Zebu calves in traditional technique appears to be more profitable if it lasts 2 or 3 years instead of one year -- i.e. if the calves are slain when they are 3 or 4 instead of 2 years old.

This result stems of course from the fact that since the land is not a scarce resource any more, it can be more widely used.

To sum up, the main interest of this alternative is to stress the fact that the implementation of more intensive, land-saving techniques cannot be avoided since the land will become a scarce resource before 1990. Furthermore, it underscores the fact that this necessary implementation of modern techniques will bring about a dramatic increase in the size of the herd.

Part IV: Project Appraisal - The Case of a Ranch

In this part, we are trying to outline what could be the specific contribution of this type of model to the economic appraisal of a particular project. Since the most widely used criterion for project appraisal is the internal rate of return, we will compare this method with an alternative utilization of the model. In this respect, two main ways of using the model can be contemplated. We can either embed in the model the specific project or assess from the model shadow prices to be used in a "classical" computation of the internal rate of return.

1. Direct use of the model

If a specific ranch project was studied, its technical data could be used to define the coefficient of an "activity" or column of the model. This colum will then have the same role as the four already existing activities that correspond to the four qualities of land.

By this use, the project would not be studied by itself but in connection with the alternative raising activities. Not only the ranch techniques, but the other raising techniques as well would then compete with this particular project for the use of scarce resources.

Consequently the economic profitability will then depend on the characteristics of these alternative techniques. To illustrate this point, we may refer to the alternatives studied in the two previous parts.

The technical coefficients of the ranch activity using the first quality of land (column F11F), have been computed from a project already contemplated. Therefore we can consider this activity as referring to

a specific project, the economic feasibility of which we want to appraise. The resulting outcome is that this feasibility depends not only on the parameters of the project proper but on the characteristics of the alternative techniques. Since these characteristics are not well known yet, we have to try out different assumptions. The outcome indicates that a further improvement in the data used is necessary before we can fully recognize the economic profitability of such a project. For example, if we retain the coefficients collected in the Ivory Coast and assume that no constraint exists on the availability of land for irrigation, the concerned ranch project does not appear to be economically feasible with a discount rate of 10 percent. To put it more precisely, this project seems less profitable than an alternative project of raising on irrigated areas. (Basic Alternative, Part II). If on the other hand, we consider that the number of cattle per hectare is more accurately assessed with the figures retained in the alternative (Part III, section 1), the outcome is different. The ranch project then appears to be economically feasible. The same result holds true too if the surface of land available for irrigation is limited to 50,000 hectares.

In this latter case, a straightforward computation of the internal rate of return would have indicated that the ranch was less profitable than the irrigation project. The ranch project could then have been discarded. The use of the model then shows that this project is yet profitable due to the shortage of land fitted for irrigation.

In conclusion, we may say that improvement of certain data is necessary before we can be positive as to the economic feasibility of

Then, once more, the model shows the interconnection of the different techniques which cannot be separately appraised. Necessary improvements in the data should provide a better understanding of the shadow prices.

Part V: Summary and Conclusion

Although some useful indications can be derived from them, the present results of the model are still tentative. Therefore, we shall here insist on their limitations before we try to sum up what appears to be the main findings of the model.

Due to the uncertainty of the data used the results have to be dealt with carefully. In particular the qualitative aspect of these results appears to be more important than the actual figures. For example, more attention should be given to the raising techniques selected by the model than to the actual index of these activities. This precaution is all the more necessary the further we go into the contemplated period. Though we may consider with suspicion the activity level reached by the irrigated raising technique in 1990 the usefulness and importance of this technique holds true. That part of the model dealing with small cattle (farm animals) and fish has mainly been taken in to exemplify the possible use of such a study. However, its results also should be considered very cautiously until the data included in the model have been improved.

This improvement of the data is necessary for all the model, if we want to get more reliable information concerning, for instance, the respective profitability of the ranch and the irrigated techniques or the economic feasibility of any specific livestock project.

But whatever the present shortcomings of the model may be, valuable information can be derived from its results. The most important

appears to be that the Ivory Coast may face a shortage of land for raising activities within the next decade. This shortage will bring about the necessity of switching to more intensive, land-saving raising techniques. It should also be useful to reduce the duration of the breeding period; the optimal age for the slaying of the calves seemingly being around two years.

If we want to summarize the indications given by the model the following picture of the Ivorian raising industry develops for the late 80's:

The "traditional" sector should be increased to the limit of the availability of land. The share of the zebus in this traditional herd could increase too since this breed seems more fitted for traditional techniques. However, the susceptibility of this breed to trypanosomiases has to be taken into account to qualify this previous consideration. Aside of the feeding of the cows on traditional grazing, the breeding of the calves on fallow with stylosanthes seems to be a profitable activity. In this case, the calves should be slain when they are about two years old.

The "modern" sector ranch and irrigated techniques will become increasingly important; it would be mainly concerned with the N'dama breed which appears more promising. This sector should be concerned with the feeding of the cows and the breeding of the calves up to the optimal age that seems to be around two years also. Besides, this modern sector could increase its capacity by buying heifers from the traditional farmer. However, it does not seem economically profitable to buy

calves from the traditional sector and breed them with modern techniques.

The productive capacities of both the ranch and irrigated techniques are limited since the supply of land for each is restricted. Thus both techniques would have to be implemented in turns, no matter which is the most profitable.

Since the irrigated technique is less well known now, it may be sensible, at first, to use the ranch technique. However, it seems it will be necessary, at least in the long run, to implement more intensive techniques like irrigation.

INTERNATIONAL DEVELOPMENT ASSOCIATION | INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT | INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

TO: Files **DATE:** February 21, 1973

FROM: Bela Balassa

SUBJECT: Comments on Ivory Coast Models

1. This note will summarize the comments I made on the Ivory Coast models at the seminar held on February 16. The comments concern the Rural Models, the Urban Model, and the Central Model. For lack of time, I have not read the paper on the educational model, nor have I participated in its discussion.

Rural Models

2. The Rural Models are of high technical quality and, with some changes in the assumptions, they should provide valuable results for the Western Africa Department as well as for the Ivorians. In the following, I will indicate the implications of certain assumptions for the results obtained and will make recommendations for changes in these assumptions. This will be done separately for the North and the South Models.

3. In its present form, the North Model assumes (a) a 2 percent annual rate of increase of wages, including wages to migrants from Upper Volta; (b) no change in productivity other than through the choice among technological alternatives; (c) a decrease in the supply of local labor from 190 thousand in 1972 to 80 thousand in 1990; (d) unchanged product prices; and (e) the shadow exchange being equal to the actual exchange rate throughout the period. Assumptions (a) and (c) represent the continuation of past trends, while (b), (d), and (e) reflect lack of information on possible changes.

4. Given these assumptions, the optimizing solution of the model shows small increases in agricultural production during the seventies and stagnation during the eighties, accompanied by declining land use and rapidly increasing wage payments to migrants (p.31). In turn, taking the Five-Year Plan's production targets as exogenous, one gets explosive increases in wage payments to migrants and declining net social regional returns (p.34).

5. The results are explained if we consider that, in the absence of increases in product prices, productivity (for a given technique), and the exchange rate, the rise in wages would lead to a deterioration of the competitive position of Ivorian producers, and regional welfare would be adversely affected by the assumed pattern of migration also. But one should not extrapolate trends in either wage changes or migration. Wage changes could be made dependent on increases in productivity while a rising supply curve for migrant workers should be assumed in conformity with the Central Model. Nor will the extrapolation of past trends be appropriate for the outmigration of local labor since preferences as regards income, the risk of unemployment, and location differ among individuals. If we take account of these factors, a deceleration of migration would ensue.

6. The assumptions made as regards productivity and exchange rates should also be modified. One may borrow the assumption of productivity growth from the Central Model, combining it with shifts in techniques in the North Model, and adopt the 25 percent increase in the exchange rate obtained in

the Central Model. I would recommend that new computer runs be made reflecting these assumptions as well as the suggestions of the preceding paragraph, prior to the mission to the Ivory Coast.

7. The results of the South Model depend to a considerable extent on the assumptions made in regard to the future course of coffee and cocoa prices, wages, and migration. On the basis of these assumptions, the conclusion is reached that production would rise at a rapid rate, with smaller increases in regional value added due to greater reliance on imported labor (p.40). The assumptions on wage changes and migration should be reviewed for this model also, and explicit consideration should be given to the implications of the export tax on coffee and cocoa for foreign exchange earnings. While in the present version export taxes are used as policy variables to affect income distribution (p.29), their more conventional role in maximizing foreign exchange receipts would need to be separately considered. Attention should further be given to the incentive effects of export taxes.

The Urban Model

8. In commenting on the Urban Model, I will concentrate on the numerical results obtained. If, for comparability with the Central Model, one takes the case with a 10 percent discount rate, a 25 percent foreign exchange premium, and the continuation of the present tax and tariff structure, the production of competitive manufacturing shows annual increases of 70 percent in 1972-75, 18 percent in 1975-80, 11 percent in 1980-85, and 1 percent in 1985-90 (p.43). These results do not appear reasonable and contrast with the smooth changes of manufacturing production obtained in the preliminary version of the Central Model which does not contain extreme values. Nor does the behavior of gross investment appear reasonable as this would involve substantial increases in marginal capital-output ratios between 1972-75 and 1975-80. Finally, questions arise as regards the lack of sensitivity of the results to variations in the exchange rate premium from 0 to 75 percent (Cf. pp.38-44).

9. In the course of the discussion, it has been suggested that the behavior of marginal capital-output ratios can be explained by the elimination of excess capacity between 1975 and 1980. This however assumes that capacity is fungible within each of the eight industries (e.g. shoe manufacturing capacity can be used in producing clothing) and that the underutilization of capacity is exclusively demand-determined. Neither of these assumptions is realistic, however, and thus we cannot postulate that excess capacity would be eliminated within a short period as demand for manufactured goods increases.

10. The peculiar behavior of the model in the first half of the seventies should further be noted. From the table on p.32 it appears that even in the most favorable case when taxes and subsidies are maintained, the interest rate is 10 percent, and there is a foreign exchange premium of 75 percent, competitive manufacturing production would decline from Cfa 59 billion in 1970 to 29 billion in 1972, only to increase again to 120 billion in 1975. In the absence of detailed information on the structure of the model, it is difficult to explain these results. But the lack of initial conditions on output has necessarily affected the estimated pattern of manufacturing production in the model as the figures for the initial year (1972) do not correspond to actual magnitudes but were derived from the model itself. In turn, the lack of terminal conditions appears to have influenced the behavior of investment while the

rigidity of the model may explain the unresponsiveness of the results to changes in the exchange rate.

The Central Model

11. The Central Model shows considerable originality, especially as far as the formulation of the objective function is concerned. It also deserves kudos for having obtained what may be considered reasonable results in its preliminary version within a very short time. In the following, questions will be raised concerning the assumptions of the model as regards the process of urbanization. Furthermore, suggestions will be made on possible uses of the model that offer general interest.

12. In the Central Model, rural-urban migration is taken to be exogenous and it is assumed that migrants who do not find other occupations will be absorbed in traditional services, thereby raising the proportion of unskilled workers in this sector from 20 percent in 1970 to 50 percent in 1990 (p.23). With decreasing productivity in traditional services, the efficiency price of unskilled workers would decline at an annual rate of 1.5 percent as against an increase of 3.4 percent for rural workers. However, equalization between the wages of urban and rural labor would be reached only in 1985 and, by assumption, this would not affect the pattern of migration (p.26).

13. The full absorption of the unemployed into the traditional service sector does not appear to be a realistic assumption. It would seem more appropriate to assume partial absorption, together with the continuing operation of the "big family" system under which those who have found jobs provide for unemployed relatives. Also, migration should be taken to be endogenous rather than exogenous of the model. We will then not have the increase in unemployed and decline in the efficiency price of urban labor obtained in the present version of the model.

14. Let me add, finally, that the model in its complete form offers an interest that transcends its usefulness for the Ivory Coast. In particular, it appears to provide an excellent vehicle for investigating the impact on shadow prices of changes in the objective function, in policy constraints, and in some of the exogenous variables. It can also be used to indicate the pattern and cost of incentives in effective protection terms and to examine the potential effects of changes in trade policies on resource allocation and welfare, with account taken of budgetary constraints. Such work could be usefully undertaken after the results of the complete model are presented to the Ivorians in April.

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