MINISTÉRIO DA AGRICULTURA
PRODUTIVIDADE E QUALIDADE

Socioeconomic Issues Linked to *Best Bets* - Modeler's Workshop

Embrapa

Documentos Nº 35

ISSN 0103-9865
Dezembro, 1997

Socioeconomic Issues Linked to *Best Bets* — 'Modelers' Workshop

Stephen Anthony Vosti
Julie Witcover
Jim Gockowski
Thomas Tomich
Chantal Line Carpentier
Merle Faminow
Samuel José de Magalhães Oliveira

Embrapa

Empresa Brasileira de Pesquisa Agropecuária
Centro de Pesquisa Agroflorestal de Rondônia
Ministério da Agricultura e do Abastecimento

Embrapa Rondônia. Documentos, 35.

Exemplares desta publicação podem ser solicitados à:

Embrapa Rondônia
BR 364, KM 5,5, Caixa Postal 406
Telefones: (069) 222-1985 e 222-3080
CEP 78.900-970 - Porto Velho-RO

Tiragem: 500 exemplares

Comitê de Publicações:

César Augusto Domingues Teixeira - Presidente
Claudio Ramalho Townsend
João Avelar Magalhães
Vicente de Paulo Campos Godinho
Samuel José de Magalhães Oliveira
Victor Ferreira de Souza

Normalização: Tânia Maria Chaves Campêlo

Editoração eletrônica: João Porto Cardoso Júnior (estagiário) e Marly de Souza Medeiros

Revisão Gramatical: Wilma Inês de França Araújo

VOSTI, S.A.; WITCOVER,J.; GOCKOWSKI, J.; TOMICH, T.; CARPENTIER, C.L.; FAMINOW, M.; OLIVEIRA, S.J. de M. **Socioeconomic issues linked to** ***Best Bets*****; modeler's workshop**. Porto Velho: EMBRAPA-CPAF-Rondônia, 1997. 35p. (EMBRAPA-CPAF-Rondônia. Documentos, 35).

Agricultura; Floresta tropical; Aspecto econômico; Derruba e queima; Tropical forest; Agriculture; Slash and burn; Economic aspect.

CDD 338.1

Sumário

Resumo 5

1. Introduction 6

2. Matrices for *Best Bet* evalution and technical notes 8

2.1. General *Best Bet* matrix for evaluating land use systems an production activities as potencial *Best Bet* for alternatives to lash-and-burn agriculture at forest margins 8

2.1.1. Technical notes on the general *Best Bet* matrix 9

2.1.1.1. Rows-land use systems/production activities 9
2.1.1.2. Columns-Smallholder's socioeconomic Concerns 10

2.2. Profitability, labor requirements, food security, and institutional issues (matrices 2,3,4, and 5) 12
2.2.1. Technical notes on the profitability matrix 12

2.2.1.1. Net present value-farmer prices 12
2.2.1.2. Net present value-social prices 13
2.2.1.3. Net present value of establishment costs 14
2.2.1.4. Years to positive cash flow 14

2.2.2. Technical notes on the labor requirements matrix 14

2.2.2.1. Establishment of activity/system 14
2.2.2.2. Operation of activity/system 15
2.2.2.3. Wage that sets PDV for activity/system to zero 16
2.2.3. Technical notes on the household food security matrix 16
2.2.3.1. Food produced by activity/system 16
2.2.3.2. Food entitlement via own production or exchange 17
2.2.3.3. Risk 18
2.2.4. Technical notes for the institutional issues matrix 20

2.2.4.1. The objective of the institutional matrix is to identify potential institutional bottlenecks and to address equity issues associated with activities/systems linked to *Best bet* technologies 20
2.2.4.2. Information intensity/diffusion 20
2.2.4.3. Imput supply markets 21
2.2.4.4. Product output markets 21
2.2.4.5. Property rights 22
2.2.4.6. Labor markets 22
2.2.4.7. Capital markets 23
2.2.4.8. "Collective Action" 23
2.2.4.9. Land/Wealth concentration 23

2.3. Lingering issues for discussion and future research 24

2.3.1. Factors held constant within the *Best-Bet* Matrices 25
2.3.2. Filling in the cells of the *Best-Bet* Matrices 25
2.3.3. Defining the rows (Systems/Activities) of the '*Best-Bet*' Matrices 28
2.3.4. System/Activity evaluations within ASB sites 29
2.3.5. Gaps to be filled 31
2.3.6. Eyeing cross-site comparisons 32

3. Socioeconomic issues linked to *Best Bets* modelers' workshop: participants'list **33**

Socioeconomic Issues Linked to *Best Bets* — 'Modelers' Workshop

Stephen Anthony Vosti[1]
Julie Witcover[2]
Jim Gockowski[3]
Thomas Tomich[4]
Chantal Line Carpentier[5]
Merle Faminow[6]
Samuel José de Magalhães Oliveira[7]

Resumo

Questões e críticas sobre os impactos da agricultura no meio ambiente são cada vez mais freqüentes. Entretanto, ainda não existe informação quantitativa que permita associar atividades agrossilvopastoris com mudanças no estoque de recursos naturais ou para comparar os retornos financeiros entre atividades alternativas. Assim, atualmente não é possível diferenciar as alternativas sob a ótica de retornos privados e sociais. Tal informação com enfoque social é crucial para a geração de políticas adequadas para a região.

Para preencher esta lacuna de informação e metodologia, a Embrapa (Empresa Brasileira de Pesquisa Agropecuária), em parceria com o IFPRI (Instituto Internacional para Pesquisa em Políticas Alimentares), ICRAF (Centro Internacional para Pesquisa em Agrofloresta) e outros órgãos nacionais e internacionais, está desenvolvendo um programa de pesquisa visando a coleta de informação nas áreas biofísica e socioeconômica, necessárias para avaliar os returnos privados e sociais de atividades alternativas e organizar as informaçãoes de maneira prática para a formulação de políticas.

[1]Econ., Ph.D., IFPRI-1200 17th St NW, Washington, DC 20036 USA, Email: s.vosti@cgnet.com
[2]Econ.,M.Sc., IFPRI-1200 17th St NW, Washington, DC 20036 USA, Email: j.witcover@cgnet.com
[3]Econ., Ph.D., IITA Cameroon, P.O. Box 025510, Miami FL-USA 33102-5510, Email: j.gockowski@cgnet.com
[4]Econ., Ph.D., P.O. Box 161, Bogor 16001, ICRAF-Indonésia, Email: t.tomich@cgnet.com
[5]Econ., Ph.D., Embrapa Acre, Caixa Postal 392, CEP 69900-000, Rio Branco, AC.
[6]Econ. Ph.D., University of Manitoba, Canadá, Depart. of Agric. Econs. # 353, Email: merle-faminow @ umanitoba.ca
[7]Eng. Agr., M.Sc., Embrapa Rondônia, Caixa Postal 406, CEP 78.900-970, Porto Velho, RO.

Este documento relata os resultados de um encontro técnico que foi realizado na Embrapa Acre, Rio Branco, AC, no período de 17 a 25 de março de 1997 para se definir as informações socioeconômias necessárias para avaliar usos alternativos de recursos naturais do ponto de vista dos agricultores. Ou seja, informações sobre fatores que possam influenciar a adoção de atividades novas. Esta contribuição, assim como a da área biofísica, foi materializada na forma de matrizes onde cada uma das alternativas potenciais, em conjunto com usos de solo (atividades) já existentes, são comparadas considerando-se diferentes variáveis. A série de matrizes e submatrizes que aparecem neste documento demostram detalhadamente como avaliar, de maneira sistemática, a rentabilidade, a demanda por mão-de-obra familiar e contratada, a segurança alimentar, e os potenciais impedimentos institucionais associados a cada um dos usos de terra. Esta avaliação permite comparar o desempenho de cada uma das alternativas. Restrições e dificuldades a esta análise são discutidas no final do trabalho.

1. Introduction

A technical workshop was convened in Rio Branco, Acre, Brazil over the period March 18th through March 25th, 1997, in order to more clearly define the objectives of socioeconomic or social science and policy research associated with Phase II of the GEF-funded Alternatives to Slash-and-Burn Agriculture (ASB) research program, and to discuss in detail the analytical methods and fieldwork required to meet these objectives, both within and across the three ASB sites represented at the meeting — Brazil, Indonesia, and Cameroon.

More specifically, there were two primary and three secondary objectives proposed for this workshop.

- **The primary objectives were:**

  - Fill in the socioeconomic 'cells' (socioeconomic issue X *best bet* technology) of the ASB *Best Bets* matrix (as identified at the most recent GSG meeting, with columns pertaining to international externalities as well as small farmer adoptability) for Brazil, Cameroon, and Indonesia, which implies, in the context (socioeconomic/biophysical reality X work to date) of each site. This would involve:

⇒ clarifying the meaning of each of the rows and columns (and the cells) of the ASB *best bet* matrix, making modifications to all, as needed;
⇒ evaluating the analytical methods proposed for filling in the cells of the matrix;
⇒ reviewing the results of preliminary empirical research (if any) aimed at filling in the cells; and
⇒ checking for cross 'row' (*best bet*), within-site comparability.

♦ Synthesize across ASB sites, which implies:

⇒ assessing the extent to which the methods and expected results will allow for comparability across sites as regards the role of socioeconomic factors (individually, or in groups) in influencing
farmers' adoptions of (and consequently the selection by ASB of) *best bet* technologies; and
⇒ establishing and setting in motion a plan for improving cross-site synthesis on this issue.

- **Secondary objectives were:**

♦ discuss the links between the socioeconomic rows and cells in the ASB matrix with the biophysical rows and cells (GEF priorities and agricultural sustainability), in the context of each site;

♦ discuss the possible policy implications of our findings;

♦ expose researchers from Cameroon and Indonesia to the 'realities' of the Brazil site.

This document contains:

⇒ the revised agenda for the Technical Modelers Workshop;
⇒ outputs ofthe workshop in the form of revised matrices and detailed notes regarding the rows, columns, and sometimes even the cells of these matrices;
⇒ a list of lingering conceptual and methodological issues requiring further thought and research related to filling in matrix cells, defining rows, evaluating matrices, expanding this framework to include those of the regional and national policymaker, and highlighting cross-site insights gained during the workshop;

⇒ a participants list; and
⇒ copies of materials presented at the workshop.

Comments are most welcome on this report, which we consider final for the purposes of inclusion in the ASB progress report to UNDP.

2. Matrices for *Best Bet* evaluation and technical notes

2.1. General *Best Bet* Matrix for evaluating land use systems and production activities as potential *Best Bets* for alternatives to slash-and-burn agriculture at forest margins

This matrix is derived from the matrix adopted by ASB at the 1996 Global Steering Group meeting, and contains modifications to that original matrix, all relevant for social science and policy research.

First, the title has been expanded to consider both land use systems and production activities (which are seen as parts of land use systems, and the focus of much of ASB technology development efforts).

Second, the scale of operation of each system/activity (that is, the scale at which farmers would normally deploy such systems/activities) has been added as a descriptive column to highlight differences across potential ASB *Best Bets* as regards scale (and hence, perhaps, adoptability by small farmers). Moreover, as will be seen in the explanatory notes, workshop participants grappled frequently with issues linked to the scale of operation at which, and over what time period given systems/activities would be evaluated for the purposes of the ASB matrix. It was agreed, however, that the scale of reporting needed to be constant within sites and across systems/activities, though differences across sites would be possible. Discussions regarding ways of 'normalizing' for within-site, across system/activity differences in scale of operation and length of system/activity 'cycle' ensued; conclusions appear in the technical notes to the matrices.

Third, the perspective towards agronomic sustainability, socioeconomic concerns, and institutional requirements vis-a-vis technology adoption was taken to be that of small farmers. For some sites, such as Cameroon, this was not perceived to be an important narrowing of actors. For other sites, such as Brazil with its three key sets of actors responsible for land use and forest conversion decisions — small farmers, large farm enterprises, and extractivists — and Indonesia, with logging companies and large scale plantations as "actors" alongside the small farmer, this narrowing of focus would be quite important.

Fourth, agronomic sustainability would be assessed at plot level, thereby precluding any research on local externalities (positive or negative) generated by ASB *Best Bet* alternatives. (Note that key international externalities are captured by the Global Environmental Concerns.)

Finally, a final column was added to capture institutional requirements associated with ASB *Best Bets*, and the extent to which these are already met at the sites.

2.1.1. Technical notes on the General *Best Bet* Matrix

2.1.1.1. Rows — Land use systems/production activities

a) A description of *Best Bet* candidate land use system or production activity; at a defined scale of operation (and a defined scale of measurement); for a given land 'type' and property rights regime; over a given time period;

- land use systems are understood as trajectories of land use from forest to the activity described;
- production activities will encompass "activity cycles" of different lengths, to include situations such as Brazil, where many *best bet* technologies are not commonly found in farmers' fields, or if they are, have not been there long enough to define a complete cycle of definitive land use; and
- actual land use systems or production activities to be evaluated will vary across sites.

b) One or more 'best guesses' for likely 'bad bets' will be included as rows in the matrix as a basis for comparison (for example, unsustainable shifting cultivation or degraded grasslands). Note, however, that table entries for particular activities vis-a-vis either 'bad bets' or 'pristine forest' might not be the relevant comparison for either policy action or technology research.

c) Some rows may not be relevant for certain communities or ecological conditions within each ASB benchmark site. For example, in Brazil, the set of candidate *best bets* for Rondonia may not overlap completely with the set for Acre.

d) Differences across sites (and perhaps especially within sites) in management techniques need to be identified and carefully documented. For example, cacao production in Brazil is not very similar (in terms of management) to cacao production in Cameroon. In some cases, particularly where management practices are known to vary substantially within sites, inclusion of more than one 'row' for a given system/activity might be advisable. For example, many definitions of improved pastures in Brazil might exist. If so, multiple 'rows' for improved pasture might be needed in the Brazil matrix.

e) In all cases, once the 'rows' have been defined, "average"production coefficients will need to be determined and used for evaluating each cell of that row. For example, financial evaluation will require an estimate of the amount of hired labor used for a particular system/activity. This estimate will have to be provided and justified, knowing that use of hired labor can vary due to household characteristics, etc., that are independent of the system/activity being evaluated. In a sense, an "archetypical household" will need to be identified, and can vary across activities/systems.

2.1.1.2. Columns — smallholder's socioeconomic concerns

a) This is a micro-based approach to understanding *Best Bets* from smallholders' perspectives; therefore, some of these measures may be irrelevant for largeholder land use systems (for example, large-scale logging or tree crop estates in Indonesia, or large farm enterprises in Brazil).

b) Scale of operation differs from one system/activity to another, and needs to be noted in a separate column. Note also that the scale of evaluation need not be equivalent across sites or across activities within sites, but that for reporting purposes the data included in the tables must be 'normalized' (temporally, and in terms of spatial units of observation).

c) The agreed-upon unit of spatial observation for reporting will be the hectare.

d) The time scale for best-bet assessment will be linked to the system/activity cycle, and may vary across "rows" within sites, and across sites.

e) The time scale used for reporting in the adoption columns will be standardized by replicating 'shorter cycle' activities/systems (where 't' is the length of the system/activity cycle) to make them comparable with 'longer cycle' activities/systems, within a given observation period (labeled "T" from now on). Note that some multiple of 't' must equal "T," which may require adjusting "T." However, "T" should be the same for all activities at a given site.

- To take an example, "T" (the time frame for activity/system evaluation) will be determined for each site. For systems/activities with cycles (that is, 't's) less than the site's "T," say, 20 years, replications of activity cycles will be done until the sum total of years (multiples of 't's) is equal to "T" (20 years in this example). So, reaching a 20-year time frame may require replicating production/activity cycles.
- This need to replicate systems/activities with 't' less than "T" to make all calculations comparable has important implications, especially taking into consideration agronomic knowledge about systems/activities to be "replicated."

⇒ If the "agronomic sustainability" column = 1 (given the land 'type' under study) activities/systems will simply be repeated until the multiples of 't' equal "T," the complete evaluation period, with no assumed loss in productivity over time. For example, pasture cycles may run 15 years, but agroforestry systems may run 20 years. In this case, we need to 'replicate' the pasture system 4 times (calculating, for example, NPV for each cycle) and replicate the agroforestry system 3 times in order to get temporally comparable systems. Note that discounting will 'erase' most differences after about year 15. Note also that some statistics do not lend themselves to replication, for example, years to positive cash flow. In this particular case, the first cycle of 't' will be the temporal basis for assessing cash flow patterns, regardless of whether or not these patterns are expected to change with replications of 't.' In other cases, similar judgment calls will have to be made, and documented.

⇒ If the "sustainability" column = 0, data are required on the effects of successive cycles on output and inputs, and these changes will be incorporated into the relevant calculations.

f) There may be substantial range within cells. Where relevant/important, this range can be included in the cells, with footnotes identifying explicitly the sources of this variation.

g) The Profitability, Labor Requirements, Foods Security, and Institutional Issues columns themselves were each 'broken out' into separate matrices, to be described below. The extent to which evaluations made in each of those sub-matrices can be "summarized" and captured in the general *best-bet* matrix was discussed case-by-case, and deserves further consideration. (This is briefly taken up in the Lingering Issues section that follows.)

2.2. Profitability, labor requirements, food security, and institutional issues (Matrices 2, 3, 4, and 5)

To better define and allow for a description of the essential elements for system/activity adoption, each of the four columns of the general ASB *Best Bets* matrix linked to technology adoption (profitability, labor use, food security, and institutional requirements) was 'broken out' into a separate matrix. The sub-matrices and technical notes (primarily) about measurement issues associated with particular columns within each sub-matrix follow.

2.2.1. Technical notes on the profitability Matrix

2.2.1.1. Net present value — farmer prices

a) Definition — net present value of each activity/system
- including all out-of-pocket costs

- including rental rates on all family-owned assets (tools, machines, barns, etc.) used in production (depreciation is discussed in the next section)
- including imputed value for opportunity cost of family labor
- excluding family land and family management

b) Farm gate or other prices relevant to farmer decisions will be used.

c) All prices and values will be reported as 1997 $U.S.

d) Discount rate
- real rate of return (opportunity cost) of capital, which varies by country
- farmer's discount rate may in part be determined by size of operational holding. Sensitivity analysis can be used to assess the implications that such differences might have on the profitability of particular activities.

e) Results of sensitivity analysis focusing on discount rate, wage rates, and output prices will be reported in supporting documents to the matrix.

f) Cross-row comparisons using NPV (mutual exclusivity assumption needs to be noted, as discussed more in the next section) — this implies that activities/systems are examined individually, and not in the whole farm context. Whole farm analyses (with or without whole farm models) will be useful to assess what is 'lost' using an activities-/systems-based approach.

2.2.1.2. Net present value — social prices

It is hoped that juxtaposing NPVs using market and social prices will identify policy (and other) distortions to markets, and signal the potential gains to particular types of policy interventions for promoting *best bet* technology adoption.

a) Definitions and technical notes — same as above, but with a different set of prices (shadow prices, border prices, world prices), where the set of prices used will be made explicit.

b) Use international prices for traded goods.

c) Try to identify market imperfections/policy distortions for non-traded goods and services.

d) Same discount rates as above.

e) Same comments on 't' and "T" hold.

f) Use Monke and Pearson, 1989 as a reference.

2.2.1.3. Net Present Value of Establishment Costs

a) Definition — Net present value of all inputs used to establish activities/systems, including imputed value of family labor and family-owned implements, but excluding family land and management.

b) "Establishment" is defined to be years to positive cash flow. We will compile both NPV of establishment costs and years to positive cash flow, and delete one if the two turn out to be redundant.

2.2.1.4. Years to positive cash flow

a) Definition — Number of years to positive cash flow — revenues from sales minus out-of-pocket expenses (including hired labor, but excluding family labor) for establishment and operations.

b) Add an asterisk in the column to indicate 'post-establishment' negative cash flow periods. Footnotes/supporting documents can describe the size of the negative cash flow, its length, or its timing in relation to establishment, if relevant.

2.2.2. Technical notes on the labor requirements Matrix

2.2.2.1. Establishment of activity/system

a) Total labor required to establish an activity/system

- Definition — total labor in person-days used in the initial phase of activity/system establishment. (This period is the years to positive cash flow indicated above in the Profitability matrix.)

  ⇒ investments occurring after the initial establishment period (such as maintenance investments) that require labor will <u>not</u> be included here

  ⇒ this cell will contain an asterisk if gender issues arise (for example, if primarily female labor is required for establishment). Footnotes/supporting documents can elaborate on gender-specific tasks.

b) Intensity

- Definition — the ratio of the number of person-days required to establish the activity/system to the number of days <u>during which</u> this labor must be applied (the raw numbers will be maintained in the ratio)
- This cell will contain an asterisk if labor needs overlap with other household activities to generate a bottleneck (where the benchmark is the typical household, both in terms of available household labor and in terms of typical production activities besides the activity being evaluated). Footnotes and/or supporting documents can be used to describe the source and severity of identified bottlenecks.

2.2.2.2. Operation of activity/system

a) Total labor for operating activity/system

- Definition — total labor used to operate/maintain activity/system once the establishment stage is finished. Note that this may or may not coincide with the onset of positive cash flow.
- This cell will contain an asterisk if gender issues arise, for example, if female labor will be used exclusively.

b) Intensity

- Definition — the number of person-days required to operate the activity/system during peak operating periods (for example, harvest time) over the number of days during which this labor must be applied (raw figures to be maintained in the ratio).

- This cell will contain an asterisk if labor needs overlap with other household activities to generate a bottleneck (where the benchmark is the typical household). Footnotes and/or supporting documents can be used to describe the source and severity of identified bottlenecks.

2.2.2.3. Wage that sets PDV for Activity/System to Zero

This number will represent the total returns to family labor, land, and management. It also gives an indicator that is analogous to the partial productivity measure 'returns to labor' often used in analysis of annual systems. (The question of human capital, or skills base, of household labor, vis-a-vis the systems/activities' requirements, is taken up in the Institutional Issues matrix, and again in the next section.)

2.2.3. Technical notes on the household food security Matrix

2.2.3.1. Food Produced by Activity/System

a) "Food" refers to the amount of food produced by a particular activity/system, which is then converted into calories, protein, and dichotomous indicators of the presence of key micro nutrients (where 'key' will be determined by site-specific, endemic shortfalls of micro nutrients — vitamin A and iron are strong candidates). Note also that foods that are produced by particular activities/systems but not normally consumed by rural inhabitants (that is, foods that are not already part of established food habits) will receive 'zero' values for the calorie, protein, and micro nutrient categories. Note also that 'foods' includes not only staples like rice, beans, cassava, etc., but also meats, milk, fruits, etc. (when they are included in the typical food basket). Our task (here) is to demonstrate increases in food availability regardless of the likelihood of it being consumed, so long as the form in which the calories/protein/micro nutrients are becoming available 'matches' food consumption habits generally.

b) Evaluation will be done over period of activity/system, "T," and may include several cycles of 't', and will be averaged (but not discounted) over that period to arrive at an annual figure. That is, the average number of calories produced per year over the evaluation period "T" — for example, rice production occurs during the first year of establishing coffee production systems (and for simplicity, 't' is equal to "T"), so average annual calorie production from rice over the entire coffee cycle will be total rice produced divided by the number of years in the coffee system cycle ('t' = "T"). This number might be quite small.

c) Calories — defined as the average annual amount of calories produced by the activity/system in the form of foods normally consumed

- total calories produced divided by the total number of years in the activity/system.
- see the discussions in I.A. and I.B. above for guidance in selecting relevant foods and time periods for evaluation.

d) Protein — defined as the average annual amount of protein produced by the activity/system in the form of foods normally consumed.

- Total grams of protein produced divided by the total number of years in the system.
- See the discussions in (I.A and I.B) above for guidance in selecting relevant foods and time periods for evaluation.

e) Micro nutrients — cells will contain simple Y/N, referring to the presence/absence in the food produced by the activity/system of one or more micro nutrients deemed to be important for site inhabitants. Footnotes can be used to identify micro nutrients, which should be related to some known micro nutrient problem at each site (that is, fruit-based systems may help address vitamin A deficiencies).

2.2.3.2. Food entitlement via own production or exchange

a) Definition — label OP (Own Production) = activity/system provides additional food production on farm; label PI (Produced Income) = activity/system only provides additional income for food purchases; label BO = both, regardless of the proportions.

b) This assessment will be made for each activity/system twice: once for the establishment phase, and a second time during the operational phase. This will add clarity and avoid a large number of cells containing "BO" due to food production during the establishment phase only.

c) Benchmark — The 'traditional' shifting cultivation system as practiced by the 'archetypical household" at each site will be the benchmark for this assessment.

d) OP/PI paths may not be mutually exclusive (depending upon issues of timing)

2.2.3.3. Risk

a) Production Risk

- Food production risk (to capture yield variability)

  ⇒ We will calculate a coefficient of variation to capture both down-side and up-side risk, acknowledging the asymmetry between the two as regards food security. Sources of risk will include weather shocks, pest shocks, and others, all of which will be explained in supplementary documents.

  ⇒ This statistic may have to be calculated at a fairly high level of aggregation (for example, municipal level), and therefore may include geographic areas and (more importantly) and households that are not in the ASB samples, as strictly defined. In some cases (especially those involving activities/systems not yet firmly established in farmers' fields) expert assessments of production risk may have to be relied upon to generate risk statistics. Judgment calls and interpretations will be needed in all cases, and cross-site discussions aimed at improving comparability at that level are essential.

  ⇒ For activities/systems that generate multiple food sources (and where sources vary as regards production risk), summary measures of risk need to be calculated. Details need more thought.

- Non-food production risk (to capture yield variability) — The same statistic (coefficient of variation) will be generated as in the case of food production risk. Issues of level at which the statistic may be calculated, and summary statistics for multiple product systems also hold, but the latter might be especially critical here.
- For all risk measured, statistics need to be chosen to avoid comparability problems

b) Terms of Trade Risk (variance in $P_{purchase}/P_{sold}$) — The precise form of this statistic needs more development. The variance over the relevant time period of the ratio of the average annual price of products purchased to the average annual price of products sold is one candidate to estimate terms of trade risk. Others might focus on capturing variance in terms-of-trade over the course of the year, or some combination to capture within and/or across-year terms-of- trade risk, as relevant.

- Purchases/sales of multiple products — Since more than one product will likely be purchased/sold in a given time period, in such cases a summary measure taking into consideration covariances and the relative importance of purchase/sales of particular items to total expenditures/income will need to be developed.
- In all cases, "purchases" refer to food; and "sold" refers to food and/or other products generated by an activity/system.

c) Overall Risk — This statistic captures combined production and terms of trade risk into a measure that is comparable across rows. This statistic will also have to be developed.

d) Weighting Risk — We need to discuss how to weight product-specific production and price risks in multi-product activities/systems, for both the traditional shifting cultivation "benchmark" and the proposed alternative. The weights assigned may not be unrelated to the "food entitlement" path of the system/activity (variation in price, for example, may not amount to risk for a product relatively unimportant as an income source). Similar issues arise in the assessment of how any two systems <u>compare</u> vis-a-vis risk.

e) Emerging Products/New Markets — The term "emerging market" or "new product" can be placed in one or more of the risk columns/cells to indicate our current inability to assess terms of trade or production risk. Alternatively, a best guess at these statistics could be accompanied by an asterisk indicating new product of emerging market status, or both, and hence the lack of information to reliably calculate risk measures.

2.2.4. Technical Notes for the Institutional Issues Matrix

2.2.4.1. The objective of the institutional matrix is to identify potential institutional bottlenecks and to address equity issues associated with activities/systems linked to *best bet* technologies.

a) In most cases (cells), we will simply include a '1' to flag the presence of a potential institutional bottleneck or equity problem, and include a '0' otherwise. Therefore, '1s' in this matrix have a 'bad' connotation — the greater the total of cell counts for a given activity/system, the greater the number of institutional obstacles it will face in being adopted.

b) Note that there is no intention anywhere in this matrix to identify <u>necessary</u> conditions for technology adoption and/or activity/system change. Agricultural and resource use change are known to occur in the absence of many of the institutional bottlenecks detailed below.

2.2.4.2. Information intensity/diffusion

a) Information gaps — do farmers currently have all the information necessary to make adoption decisions regarding systems/activities containing *best bet* technologies? '1' means no.

b) If not, are farmers capable of either getting this new knowledge on their own (for example, from the market) or generating it on their own (for example, learning which soils are best suited to a new technology)? '1' means no.

c) If farmers CANNOT obtain or generate this information, is there a research and extension service in place that has the capacity to generate and diffuse this new information? '1' means no.

2.2.4.3. Input supply markets

a) Objective — assess the extent to which input markets (other than factor markets, dealt with below in separate sections for labor and capital markets, with land markets discussed under Land/Wealth Concentration) perform the basic functions required for technology adoption. In all cases, '1' signals that basic market functions are NOT being performed.

- list of market functions will include:
  - ⇒ product transformation
  - ⇒ transportation
  - ⇒ processing
  - ⇒ storage
  - ⇒ others

- cell will contain a '1' only if purchased inputs (other than labor) are required for technology adoption.

2.2.4.4. Product output markets

a) Objective — assess the extent to which output markets perform the basic functions required for technology adoption. In all cases, '1' signals that basic market functions are NOT being performed. The list of market functions will include:

⇒ product transformation
⇒ transportation
⇒ processing
⇒ storage
⇒ others

2.2.4.5. Property rights

The objective is to determine whether or not property rights linked to systems/activities assigned and secure. In other words, do existing institutions, regulations, and laws establish and enforce clear resource access and property rights? Again, '1' here means no.

a) Refers to land, water, trees (all factors of production), and the products themselves.

b) Supporting text will detail shortfalls in property rights, if any, and how they influence adoptability of the system/activity under evaluation. For example, in the Brazilian case, do farmers adopting coffee production technologies have legal protection from risks of fires started by neighbors? Probably not.

2.2.4.6. Labor markets

a) objective — assess whether or not unskilled and/or skilled labor are available to adopting farmers via formal or informal markets, and at a wage determined by these markets. '1' means no.

b) Special attention needs to be paid to seasonal failures in labor markets.

c) Cells will contain '0' or '1' in each column only if that type of labor (unskilled or skilled) is required for technology adoption.

2.2.4.7. Capital markets

a) Objective — assess whether or not non-price methods are used to clear capital markets. For example, do potential adopters of *Best Bet* technologies have access to formal and/or informal credit markets, and is the cost of capital determined in the market? If the answer to either is 'no,' then this cell will contain a '1.'

b) Again, this cell will contain an entry only if credit is required for technology adoption.

2.2.4.8. "Collective Action"

a) Objective — assess the importance of collective action that is NOT linked to scale economies in production or complementary investments required for technology adoption. If such collective action IS REQUIRED, then the cell will contain a '1.' For example, in the Brazilian context, the adoption of a legume-based pasture requires that neighboring farmer NOT burn on their land, regardless of their land use patterns. Or, making particular land improvement investments in low-lying areas might require similar investments in upland areas. In both the case of pastures and land improvements in low-lying areas, the collective action cells would contain a '1.'

b) "Collective action" here focuses on the actions (or lack thereof) of groups of individuals, and NOT on the planning that might be required to coordinate such activities.

2.2.4.9. Land/Wealth concentration

The objective is to assess the potential for technological change to lead to land (or wealth) concentration due to economies of scale in some aspect(s) of production, including harvesting. If this is likely to occur, the cell will contain a '1.' There are two dimensions to this issue:

a) Scale economies have to be demonstrated for the activity/system; and

b) The organizational/institutional checks to land/wealth concentration need to be absent, or at least unlikely to function well. If both these conditions are met, then the cell will contain a '1.' For example, if technological change leads to an increase in the optimal scale of operation and land rental/leasing markets do not function properly, then land concentration might be expected.

c) Divisibility of land holdings linked to technology adoption, although not explicitly discussed at the workshop, is another dimension tied to functioning of local land markets that may be relevant to evaluation of particular systems/activities.

2.3. Lingering issues for discussion and future research

The following issues, discussed during the workshop, sometimes went unresolved even for the purposes of filling in the *Best Bet* matrices. The lingering issues fell roughly into several broad categories (although some spanned categories, and others fell neatly into none) — a) import of factors held constant within the '*best-bet*' matrices; b) challenges of filling cells of the '*best-bet*' matrices (measurement and reporting, with a particular emphasis on measurement difficulties arising out of the time scale for evaluation proposed); c) problems in, and suggestions for, defining the rows of the '*best-bet*' matrices; and d) a look at what evaluations using the '*best-bet*' matrices must, or should not, entail. This last category itself includes comparing information across rows, summarizing 'row' information, and looking across matrices. A final category highlights critical gaps in the analytical framework presented here, most notably its need to bring in the perspective of the national or regional policymaker in interpreting or expanding on the matrix information. These groups of issues are listed here (in no particular order) to prompt more thought by ASB as we attempt to complete the matrices presented above, and more generally. The section concludes with a brief word on gains made in cross-site comparison, particularly vis-a-vis socioeconomic research and policy analysis, during the workshop.

2.3.1. Factors held constant within the *Best-Bet* matrices

a) Archetypical households — The need for inventing an archetypical household to perform needed calculations was agreed upon. The dangers associated with this necessary evil were also discussed. Where the characteristics of rural households vary substantially, sensitivity analysis might be used to assess the impact of changes in these on activity/system performance. This might be particularly important when estimating the use of hired (versus household) labor, and assessing the impact on activity/system costs of this key cost.

b) Homogeneous 'Land Type' — Similarly, the need to compare systems/activities across rows necessitated a focus, for a given matrix, of a particular land type, on which all systems/activities would be evaluated. For each site, this means strategically choosing one among several land types for the initial evaluation, justifying this choice, and documenting, where possible and thought to be important, the actual or expected effects of a shift in land use type for a given system/activity.

c) Sensitivity analyses — Many candidates (too many to be practical) for sensitivity analyses were discussed at the workshop. In addition to soil types/qualities, and characteristics of archetypical households, parameters needed to characterize systems/activities for evaluation in one or more matrices, such as technical coefficients, market prices, social prices, and discount rates. Doing sensitivity analysis on discount rates, price changes, and some key technical coefficients would probably be wise for all sites. The results could either be presented as footnotes to the tables, or in supporting documents.

2.3.2. Filling in the cells of the *Best-Bet* matrices

a) Measurement error — Questions regarding the precision with which we might expect to measure key inputs and outputs linked to systems/activities containing *best bet* technologies arose constantly. In some cases, available measurement instruments will be quite blunt — for example, county-level prices for particular products would be used in calculations, knowing that substantial within-county price variation existed due to differences in access to markets and product quality. In other cases, no measurement instruments exist at all — for example, the definitions and relative importance of skilled versus unskilled labor in emerging activities/systems is not known, and therefore cannot be currently measured. Finally, in most cases it was not clear what proportion of within-cell variation might be due to measurement error versus other sources of variation, such as unobserved differences in key underlying inputs (for example, management practices).

b) Ranges of Values within Cells — With the exception of cells containing dichotomous entries, ranges of values within cells arose as an issue. Where ranges are large and researchers are confident of the dispersion, ranges themselves (rather than means or some other statistical measure of centrality) might be entered in a cell. In all cases, discovering and reporting (perhaps as footnotes to tables) the source(s) of the ranges of values was deemed to be critical, and probably more important than the ranges themselves. For example, if a wide range of profitability numbers were discovered for improved pastures in Brazil, the challenge would lie in figuring out the source of this variation (for example, management practices).

c) Thresholds — Thresholds were discussed at length in the context of several columns of the sub-matrices presented above. Poverty thresholds were discussed in the context of the food security matrix — how close to being food insecure a household is should influence our assessment of the importance of (for example) shifting from own production to purchasing food. Likewise, key information would be lost by noting only the number of years to positive cash flows for activities/systems, since huge losses in the post-establishment period would be given the same weight as trivial losses. These issues need to be addressed in almost all columns; their relevance might vary across systems/activities, too. To some extent the identification of such thresholds can inform both sensitivity analyses, and when, where, and how to report ranges.

d) Time scale — Implications

- Discount Rates — A perennial problem for all evaluations over time, this problem is generally handled by replicating evaluations at different discount rates and reviewing the outcomes. That can be done here, too. However, this is a particularly difficult issue for our task due to possible differences among actors in discount rates. For example, large plantation operations in Indonesia with direct links to capital markets might have very different discount rates than small farmers without access to formal credit. We may have to use different discount rates for different activities/systems if such cross-actor differences are confirmed, and if we can make reliable matches between groups of actors and particular activities/systems.

- Depreciation — The depreciation of family-owned assets in the production process needs to be explicitly incorporated into all relevant evaluations. Reductions in expected productivity of these inputs needs to be noted, too. Finally, and perhaps most difficult, the changes in the productivity of labor of the sometimes long evaluation periods needs to be dealt with — a 20-year time frame will mean that half a generation will pass during the evaluation period for some systems/activities. We need to assess the impact of likely changes in (for example) household composition on technology performance over that period, at least subjectively.
- Replication versus Multiplication — As indicated earlier, short-cycle activities/systems will have to be 'replicated' so that the time frame for evaluation will be the same for all systems/activities. In the (probably rare) cases in which the actual replication of an activity/system leaves the natural resource base (sustainability exactly equal to 1) and the archetypical household unchanged, this method is fine. However, if agronomic conditions are improved (sustainability greater than 1), our measures of performance/adoptability will only capture improvements that enhance yields for the systems being evaluated. Productivity improvements that might go to other crops, or increases in wealth not linked to productivity increases will not be captured. Perhaps more worrisome, if the natural resource base is degraded (sustainability = 0) much more information will be needed on the impact of activity/system replication on the resource base in order to generate reliable evaluations.
- Biophysical Measurements Over Time — Methods for taking into consideration systems/activities with different cycle lengths, and making evaluations for longer temporal scales for the socioeconomic 'side' of the matrix are detailed above. However, this issue needs to

be addressed in the rest of the general *Best Bet* matrix, and methods deployed in the biophysical 'side' of the matrix need to jibe with our treatment. This might be especially critical for the agronomic sustainability column (as one of the adoptability columns), now treated (by us) as dichotomous.

- Risk — While there is some uncertainty regarding the agronomic performance of some systems/activities, we often know virtually nothing about the several types of risk (production, market, etc.) the producers of these new activities/systems will face. This is particularly true in Brazil, where new products in settlement areas are neither stable nor well integrated into regional markets. Innovative measures of risk will be needed in these cases.

2.3.3. Defining the rows (Systems/Activities) of the 'Best-Bet' matrices

a) Land use systems versus production activities — From the outset, the notions of land use systems and production activities, and where *best bet* technologies fit into both, presented some difficulty for both identification of "rows" and cross-site analysis. At some sites, such as Indonesia, where systems and the activities that make them up have had sufficient time to 'settle down' into general patterns, the notions were easy to separate. In other sites, such as Brazil, where smallholder production systems, and the economic and biophysical environments shaping them are still in substantial flux, stable systems in particular, but also production activities, were difficult to define in the precise manner needed. Clarity in defining both the system/activity and the scale of evaluation were deemed critical. Interaction among researchers during the periods of system definition will increase the value and reliability of cross-site comparisons.

b) "Close Cousins" to Potential *Best Bet* Technologies — Defining *best bet* technologies, and in many instances the systems/activities that contained them, was a non-trivial task. In some cases, within-cell variations may well be due to the lack of precision with which we define systems/activities containing *best bets* (thus leading to measurements being taken on what are actually different systems). As we move forward in filling out the proposed matrices, due thought needs to be given to the impact of imprecise definitions to system/activity evaluation, reporting, and cross-row comparison. The group underlined the importance of capturing the 'trade-off' in critical biophysical and socioeconomic parameters, as well as farmer know-how (vis-a-vis the *best bet* itself) associated with particularly likely or prevalent *best bet* 'close cousins.'

c) Variations in Key Factors of Production — As indicated earlier, variation at farm level in key agricultural inputs and/or management practices can dramatically alter the 'performance' — both biophysical and socioeconomic — of systems/activities. Some method needs to be introduced to control for such variation, and to measure its impact.

d) Scale Issues — More thought needs to be given to the spatial scale at which systems/activities are evaluated, and the scale at which the results of these evaluations are reported in the *best bet* matrix. At a minimum, this information has to be contained in all tables, and some discussion of the potential for realistically scaling up or down at farm level must be addressed. This is critical in cases where economies of scale in some aspects of production/processing change the costs associated with production/processing as the scale of operation changes. For example, the results of our evaluation of pastures in Brazil will be reported on a per hectare basis, but the likelihood of owners of one-hectare plots to adopt this technology is low. Some scope for addressing this topic already exists within the institutional issues matrix.

2.3.4. System/Activity Evaluations within ASB Sites

a) Cross-Row Comparisons, Mutually Exclusive Activities, and NPV — Within the profitability matrix, one reason for choosing NPV as a measure was to allow a ranking of rows. However, one of the notions embedded into NPV evaluations is that activities are somehow mutually exclusive — farmers chose between one system or another, but do not do both. We know this is not true in many cases, and some assessment of the potential for combinations of activities/systems involving *best bet* and/or other technologies needs to be done. Formal modeling at household level would be ideal, but other acceptable methods are available. Other 'cross-row' comparisons within particular columns deemed of use should be similarly scrutinized for methodological pitfalls or caveats.

b) "Summing Up" Across Columns for Given Systems/Activities — Given the diversity of measurement tools and analytical methods deployed across the different cells of the *Best Bet* matrices for given rows, it will be extremely difficult (indeed probably impossible) to quantitatively distill for each row a single measure capturing the information, for example (in the case of the General *Best Bet* Matrix), on international externalities, agronomic sustainability, and technology adoption concerns. Moreover, trying to create such summary statistics might be unwise for several reasons. First, a uniform summary statistic might not reflect the 'weights' needed in specific cases for a realistic evaluation. For example, 'fatal doses' noted in a particular column might 'kill' a particular technology, regardless of how well it 'scores' in other cells. The problem can compound itself if the effort to generate summary statistics within matrices should expand to generating summary statistics across matrices. Second, units of measure vary widely across columns, and no "common denominators" were identified. At the end of the day, we will need to make broad assessments of technologies, and make comparisons among them. More thought as to how this process should be carried out is needed.

c) Linking the *Best Bet* Matrices — Although it may be misguided at this point to attempt to create uniform summary statistics that link the *best bet* matrices one to another (and particularly the sub-matrices to the General *Best Bet* Matrix), it would be equally misguided to ignore that the issues raised in each matrix are meant to be considered in a broader, cross-matrix context, and that specific column-to-column links across matrices may yield fruitful insights (for example, labor intensity in the labor requirements matrix, in the light of whether markets for skilled and unskilled labor function in the region, from the institutional issues matrix). As noted above, how the information is processed to reach overall evaluations on systems/activities deserves more consideration.

d) Links between Biophysical and Social Science Aspects of *Best Bet* Matrices — These links were discussed, with particular focus on the agronomic sustainability column. More needs to be done, particularly assessing the impact of some of the global change variables on technology adoption potential. The below-ground biodiversity work would seem to offer an excellent opportunity in this regard. Such links imply getting a handle on how temporal and spatial measurement and reporting issues might vary for the biophysical, vis-a-vis the social science, columns, and the implications of those differences for how the biophysical/social science links may be perceived.

2.3.5. Gaps to be filled

a) Policy-focused view of *Best Bets* — There are two interest groups explicitly 'targeted' in the general *Best Bet* matrix: the international community concerned with global externalities, and small farmers who might eventually adopt *Best Bet* technologies. A key interest group not explicitly mentioned in the matrices are policymakers, who may place different weights on the information contained in the matrix, or who may find our matrices lacking key information. Therefore, we need to find ways to inject regional and national policymakers' concerns into the *Best Bet* matrices, and distill from the matrices messages relevant to policymakers. One entry point already devised in the profitability matrix is the use of different sets of prices to highlight effects of existing policy distortions or potential policy action.

b) Meso issues — Related to the above, in the process of tackling very macro (GHG emissions) and very micro (farm household) issues, this analytical framework does not explicitly address on important meso issues, such as labor absorption and employment generation, the impact of increased output supply and/or input demand in regional markets, etc. These are probably among the most important issues developing country policymakers need to deal with, and information contained in the matrices (including that about labor requirements, institutional frameworks, and local market function failures) is vital input into addressing them. At a minimum, supporting documents to the matrices should elaborate on the implications of matrix information to such meso-level concerns, wherever possible.

c) Local externalities — ASB is collecting lots of data on international externalities — GHG emissions, biodiversity, and carbon stocks. However, local externalities (the spill-overs across farms or groups of farms) linked to activities/systems are rarely addressed. Ironically, these spill-overs may be of most interest to policymakers in the developing world. Ways to incorporate them or other frameworks to address them need to be devised. Note that information gathered for the "collective action" column in the institutional issues matrix is a start in this regard.

2.3.6. Eyeing Cross-Site Comparisons

The initial aim of the *best bet* matrices is within-site evaluation, as a necessary but insufficient step towards the ASB broader aim of getting at the roots of similarities and differences in tropical forest margin zones throughout the world. The emphasis placed here on measurements that enable cross-site comparability without compromising within-site evaluation is a step toward that broader aim. Another was agreement that careful looks across rows for the technology adoption columns, less with a view towards ranking systems/activities, and more with one towards gleaning common policy levers that might affect local land use systems/activities more broadly, would, especially in cross-site analysis, yield important insights (and discussions in the workshop and in the field touched frequently on cross-site differences and similarities in this regard). Variation in the degree to which land use systems/activities of interest were found 'on the landscape' and were stable came up repeatedly, not unrelated (as mentioned earlier) to the degree to which the study site was clearly a frontier area, or already a stable settlement. This theme arose in conjunction with other important topics, some already touched upon in this report (for example, the need for the framework to handle both land use systems and activities, the challenges in defining best-bet technologies, etc.), others unmentioned but important, such as the nature of agricultural research vis-a-vis what is found in farmers' fields (and the interchange among agricultural research and farmer practices). The ASB analyses will need to devise ways to more clearly formulate and test hypotheses stemming from these observations.

3. Socioeconomic issues linked tO *Best Bets* modelers' workshop': participants list

Merle Faminow - University of Manitoba
Address: Department of Agricultural Economics # 353
Agricultural and Food Sciences Building 66
Dafoe Road Winnipeg, Manitoba
CANADA R3T 2N2
Phone: (204) 474-9609
Fax: (204) 261-7251
Country code: 1
Email: merle-faminow@umanitoba.ca

Samuel Oliveira - Embrapa Rondônia
Address: EMBRAPA-CPAF-Rondônia
BR 364 Km 5
Porto Velho -Rondônia-Brasil
CEP: 78900-000
Phone/fax: (55) 069-222-3080
Email: samuel@enter-net.com.br

Jim Gockowski - IITA - Cameroon
Address: IITA Cameroon
P.O. Box 025510
Miami FL - USA
33102-5510
Phone: (237) 237522
Fax: (237) 237437
Email: j.gockowski@cgnet.com

Thomas Tomich - ICRAF - Indonesia
Address: P.O. Box 161
Bogor 16001 Indonesia
Phone: (62251) 315234
Fax: (62251) 315567
Email: t.tomich@cgnet.com

Jose Mauricio Fernandes - CNPT
Address: EMBRAPA-Trigo
C.P. 569
CEP: 99001-970, Passo Fundo, RS - BRAZIL
Phone: (054) 311-3444
Fax: (054) 311-3617
Email: mauricio@cnpt.embrapa.br

Vitor Afonso Hoeflich - CNPF
Address: EMBRAPA-Florestas
Estrada da Ribeira, Km 111
Caixa Postal 319 - Guaratuba
CEP: 83411-000 Colombo -Paraná-Brasil
Phone: (041) 766-1313
Fax:(041) 766-1276
Email: hoeflich@cnpf.embrapa.br

Yashihiko Sugai - SEA Brasilia
Address: SAIN W3 (FINAL), Parque rural
CEP: 70700-901 Brasilia, DF, Brasil
Phone: (061) 348-4430
Fax: (061) 347-4480
Email: sugai@sede.embrapa.br

Judson Ferreira Valentim - EMBRAPA - Acre
Address: EMBRAPA - Acre
Caixa Postal 392
CEP: 69900-000 Rio Branco- Acre - Brasill
Phone/fax: (068) 224 - 4035
Email: valentim@microdata.mdnet.com.br

Julie Witcover - IFPRI
Address: IFPRI - 1200 17th St NW
Washington DC 20036 USA
Phone: (202) 862 - 8144
Fax: (202) 467- 4439
Email: j.witcover@cgnet.com

Stephen A. Vosti - IFPRI
Address: IFPRI - 1200 17th St NW
Washington DC 20036 USA
Phone: (202) 862-8138
Fax: (202) 467-4439
Email: s.vosti@cgnet.com

Chantal Line Carpentier - IFPRI - Brazil
Address: EMBRAPA -CPAF/Acre - Brasil
Rodovia BR 364, Km 14
Phone: (068) 224-3931, 224-3932, 224-3933
Telefax: (068) 224-4035
Caixa postal: 392
CEP: 69908-970 - Rio Branco, Acre
Email: chantal@microdata.mdnet.com.br

Anexos

Matrix 1 – Matriz for evaluating Land Use Systems and production Activities as Potential *Beste Bets* for Alternatives to Slash-and-Burn at Forest Margis (General *Best Bet* Mattrix).

Land Use Systems/Production Activities		Global Environmental Concerns				Smalholders´Agronomic Concerns	Smalholdersr´ Socio-Economic Concerns			Institutional Requirements
Description	Scale of Operation Evaluation	Carbon Stocks	CHG Emissions	Biodiversity		Sustainability (at the plot level)	Profitability	Labor requirementes	Food security	Institutional Endowments
				Above-ground	Below-ground					

Matrix 2 — Profitability

Description of System/ Activity	Net Present Value Farmer Prices	Net Present Value – Social Prices	Net Present Value of Establishment Costs — Farmer Prices	Years to Positive Cash Flow

Matrix 3 — Labor requirements

Description of System/Activity	Establishment Phase		Operation Phase		Wage to set PDV to Zero
	Total Labor	Intensity	Total Labor	Intensity	

Matrix 4 – Hoesehold Food security

Description of System/Ac -tivity	Nutritional Value of Food Produced in the System/Activity			Food Entitlement Via: Own production or Exchange		Risk of Food Entitlement Failure			
	Calories: avg kcal /ha/yr	Protein: Avg kg/ ha/yr	Micronutrient s	Establishimen t	Operatio n	Production Risk		Terms of Trad Risk	Overall
						Food	Non-food		

Embrapa

Empresa Brasileira de Pesquisa Agropecuária
Centro de Pesquisa Agroflorestal de Rondônia
Ministério da Agricultura e do Abastecimento
BR 364 km 5,5 CEP 78900-970, PABX: (069)222-3080, Fax (069)222-3857
Porto Velho, RO

Patrocínio:

PLANAFLORO

Brasil EM AÇÃO