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The Land Evaluation System for Family Agriculture Suitability (SIATe), developed for the Brazilian agrarian reform

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Abstract

The Brazilian Federal Constitution attributes the Union to expropriate land that does not fulfill its social functions for Agrarian Reform (AR). In the period of 1995 to 1999 the AR settled 372,866 families. Among the social functions of land it is stated that land has to be adequately explored. The land evaluation procedures to verify the unproductive status and the feasibility for family agriculture were not specifically designed to support AR surveys. The none consideration of important variables known to be directly linked to the development of the settlement projects is a strong indicator for the unsuitability of current procedures. This paper describes SIATe (Land Evaluation System for Family Agriculture Suitability) an expert system developed for land evaluation for the Brazilian AR. SIATe is a regional system based on land suitability concepts with internal modules related to land qualities, regional conditions, land use types and analytical modules.

Keywords: Agrarian Reform, Land Evaluation, Expert System, Brazil.

Introduction

The Brazilian Federal Constitution attributes the Union to expropriate land that does not fulfill its social functions. The social functions comprises an adequate (i.e. productive) and rational agricultural or forestry exploration and the environmental protection. The National Institute for Colonization and Agrarian Reform (INCRA) linked to the Ministry of Agrarian Development (MDA) is the federal agency responsible for the expropriations. The Brazilian official Agrarian Reform (AR) is based on the conversion of the expropriated unproductive large farms into small units, operating on a family agriculture basis. For that, INCRA acquires the large farms based on current market values and refinance it under special and attractive conditions to a large number of landless families, usually rural workers living in poverty conditions.

INCRA has a staff composed of 5,782 employees spread out over all Brazilian territory. From these personnel 450 (200 graduated agronomist and 250 agricultural technicians) are exclusively performing land evaluation. In average, 3,000 farms are evaluated each year with the main objective to check for the adequate and rational exploration and for its suitability for family agriculture. As a result of this efforts, in the period of 1995 to 1999, INCRA has settled 372,866 families (average of 74,573 families or 372,800 persons each year) creating 2,723 settlement projects on 8,785,114 ha of land. In average values 545 projects were created per year, expropriating 1,757,022 ha each year (INCRA, 2000). This challenge consumed a mean annual budget of U$ 1,200,000,000 (Gasques & Verde, 1998 and INCRA, 2000). Due to the magnitude of these numbers, the Brazilian AR is considered as an effective example of promoting income equality distribution via family farm improvement and is a direct response to organized social movements such as the Landless Rural Workers Movement (MST) and the Confederation of Rural Workers in Agriculture (CONTAC) (Guanziroli, 1999).

The adequacy of a farm to be used for AR is based on three main issues: a) compatibility of land quality and agricultural production under current land use and b) expected performance under family agriculture and c) environmental protection. Conceptually, a large farm (or part of it)

is considered adequate for AR if it is not an environmentally protected area, is currently unproductive (i.e. not fulfilling its social function by producing goods and employment) and can be profitable and productive if divided and managed under family agriculture. The criteria for environmental protection is the accordance to the Brazilian environmental legislation. Thus, protected areas or of special environmental interest are automatically excluded as suitable for AR. This legislation based criteria is well described, objective and usually easy to apply during land evaluation. Although, the procedures used to define the current unproductive status and the expected profitability and feasibility under family agriculture are more subjective and inexact. The undeserved evaluation of the current unproductive status may be unjust for the land owner and the misevaluation of the feasibility for family farming may impair the development of the settlement. In the first case the land owner will doubt the land evaluation result and ask for the reintegration of property and in the second the settlement will be abandoned or poverty will remain.

The characterization of the unproductive status and the suitability for family agriculture are regulated by a law described in the Normative Instruction 31 (INCRA/DF, 1999). This instruction, and its previous versions, establish a maximum and a minimum exploration level based on land capability classification (LCC) concepts (Klingebiel & Montgomery, 1961). If a farm does not match the minimum exploration level it is considered unproductive. If this unproductive area achieves land capability classes compatible with extensive or intensive agricultural production it is considered feasible and profitable for family agriculture. The accordance to these two conditions together with the environmental aspects are enough to in fact convert a large farm to a settlement project. The LCC was developed in the 50s to support USDA soil conservation decisions and is far from being a modern land classification system with respect to theoretical background and compatibility with modern land evaluation technologies (Diepen et al., 1991). Although, this classification system is attractive due to its simplified class structure based on 8 possible classes from the most suited land for annual crops

represented by class " I " up to the land unsuited for agriculture on class " XIII ". The advantage of being easy to understand is widely surpassed in importance by its disadvantages. The most important aspect is the not at all consideration of not physically based important variables known to be directly linked to the development of the settlement projects (Guanziroli et al. 1999). This is a strong indicator for the unsuitability of Normative Instruction 31 as a decision supporting tool for a program from the magnitude and social relevance of the Brazilian AR.

This paper describes SIATe (Land Evaluation System for Family Agriculture Suitability) that is an expert system developed to support land evaluation decisions for the Brazilian AR in substitution to the currently used methods.

Material and Methods

Data collection and field work

Most data used to structure SIATe were obtained during field work. From August, 1999 until July, 2000 the authors made ≈ 60 one-week field trips together with the land evaluation personnel form INCRA. During this field trips, covering the whole Brazilian territory, soil and landscape relations to land use types and settlement development were observed and ≈ 150 settlement projects (SP) were visited. Settled farmers, extensionists, politicians, researchers and local INCRA staff were interviewed and the available printed data were collected (internal reports, maps, surveys). Each region was visited at least twice. The first visit for collecting the data was followed by its systematic organization as a report, comparison and complementation with data collected in other localities and the clear definition of the most limiting or favorable aspects for the local development of family agriculture. The second visit had the objective to locally revise and validate the conclusion and establish a permanent feedback action with local actors. After the second visit the limiting or favorable aspects related to the development of family agriculture were described and the most promising land use types listed.

The structure and procedures of SIATe

SIATe was developed to operate strictly at local level, evaluating essentially settlement projects or areas to be converted to AR. This excludes SIATe of being a complete tool for regional or countrywide planning. Although, the data generated by SIATe or the variables considered for local land evaluation can be useful in frames that operate at this scale. SIATe is based on land suitability concepts (FAO, 1976) with internal modules related to land qualities (soil and landscape), regional conditions, land use types and data analysis (suitability and feasibility).

The modules related to soil and landscape variables were designed to operate with expeditious field surveys as described by Becket & Bie (1978) for the land-system based survey. Nevertheless, if available, more detailed surveys can be also used. The land qualities are qualitatively rated based on decision trees where soil analysis results, soil morphological field observations and slope parameters are used as inputs.

The regional conditions are pertinent to the factors that surround the SP, are not physically based (i.e. are not related to land qualities) but may systematically influence its development. The same way as for land qualities, SIATe was designed to operate these variables based on local knowledge, simple census data or on more complex economic projections or social surveys. The regional conditions are also rated qualitatively and a precise definition for each quality class is presented. Both, land qualities and regional conditions, will define the supply of conditions for developing family agriculture for a SP in a specific region. These supplies are compared with the demands defined in an internal database of land use types in an analytical module. This module will calculate several percentage basis records reflecting the deviations between supplies (related to the SP) and demands (related to the land use). For each suited land use type SIATe will check for feasibility. The feasibility is calculated based on economic and expected yield data available in the internal land use database resulting in income and spare capacity values. The maximum value to be paid to acquire the area is

also calculated. The concept and programming of SIATe will allow constant countrywide updates considering that at least, the land use variables are expected to change rapidly. New land use types, yield rates or mean market prices will have to be constantly introduced or revised in the system. SIATe was also developed to be applicable without increasing significantly the time and the resources needed for land evaluation, as compared to current procedures, and requiring only minimal training for its implementation.

A complete simulated SIATe run was tested two times in operational filed conditions by personnel of land evaluation from INCRA together with local settled farmers and extensionists under the supervision of SAITe developers. The first test was performed during September, 1999 at the Brazilian central plateau (Palmas) with a prototype of SIATe and the second during July, 2000 at the Southeast part of Brazil (Betim and Belo Horizonte) with the first complete beta version of the program. SIATe is currently (paper submission date) running on a final beta version and it is expected to substitute current land evaluation procedures in 2001.

Results and Discussion

The acceptance of SIATe

SIATe will be used systematically (≈ 3,000 farms evaluated per year), countrywide and by users with different professional background and experience. If the trend of the last 5 years continuous, 20 % of the evaluated areas will be expropriated, divided in small farms and distributed to poor families that are expected to improve based on family agriculture. The Brazilian AR is an efficient governmental strategy to overcome rural poverty, deals with very sensitive issues such as land property writes and is supported by organized social movements (e.g. MST) that push the government and influence the public opinion. A key aspect for an expert system that will operate land evaluation within this context is its acceptance among the different actors involved. The way the data were collected to structure SIATe makes it reflect the local knowledge and experiences about AR and family agriculture. The

feedback visits, where the initial reports were revised and validated, contributed significantly to improve the decision trees and definitions. The receptivity for SIATe among personnel of INCRA is very positive, even knowing that the new system will require training to learn how to collect data and operate the system and more time spend in more exhausting field surveys. The final impacted i.e. the clients of INCRA who will receive the land and will have to honor the payments for that, are hopeful that this new system can avoid misevaluation problems. For both sides the hope is that unsuited soils or the location of the settlement in a region where the chances to develop family farming are foreseeable restricted, will be better detected and avoided.

The first field test, performed based on a prototype of the program, was important to confirm that the overall conception and strategies were adequate and allowed an early detection of weak points. The second test, on a running beta version, showed that the adjustments were correct and allowed a fine tuning that is essential to release a first operational version. The decision of collecting most data by field surveys involving a great number of actors consumed more time for developing SIATe if compared to the time needed if most data would be extracted from bibliographic sources. Although, this strategy was essential to generate a positive atmosphere of hope and confidence around SIATe, which was absolutely discredited at the beginning of its development. The none acceptance of SIATe by INCRA's staff directly working with land evaluation or the distrust of the organized social movements or family farmer leaders in relation to its benefits could easily result in a political conjuncture that would bring to an early collapse of the project or resistance for its launching. The "dare-to-share" approach and the actual involvement of all actors allowed SIATe to reflect the hopes, needs and experience from both sides. The acceptance of SIATe as a substitute for the currently used procedures is certainly related to the way it was developed.

The field surveys

SIATe will operate in a wide range of conditions. Large scale remote regions covered mostly by forests with access only by boat in the

Amazon, almost inhabited and with extreme climate semi-arid conditions at the Northeastern part of Brazil and the industrialized subtropics represented by the Southern Brazilian States are some examples of this range. The sources and scales of the available soil and landscape information are also extremely variable. In remote regions basic topographic data are available at a scale of 1:500,000 and soil and geomorphologic maps at 1:1,000,000, both incompatible for local land evaluation. In part of South of Brazil topographic contour maps are available at the scale of 1:10,000 and soil maps at the scale of 1:100,000. Perform extensive field surveys, producing standard soil and geomorphologic maps compatible with local land use planning actions is impossible due to practical reasons. The effort for training 450 professionals with distinct background and experience spread out over a territory with 8,547,403 km ^{2} would widely surpass the available resources and time. Intensive surveys would increase dramatically the time needed for land evaluation not allowing INCRA to honor its targets and compromises for settling people. Another reason to avoid intensive surveys is that in most regions where the AR is active the cost of the surveys would surpass the cost for acquiring the land. These reasons forced to design SIATe to operate without a standardized basic data scale and format, and the development of a field data collecting procedure that is easy to learn, expeditious and relatively precise in dividing and characterizing the main landscape units.

The suggested field procedures are based on land-system concepts, described in Becket & Bie (1978), adapted to fit and improve the procedures in use. Currently adopted procedures determine that the area has to be measured using DGPS technology with support of remote sensing data. INCRA is structured to operate DGPS and has easy access to Landsat TM satellite printed and digital images countrywide. In the majority of the cases, no detailed bibliographic data will be available. Therefore, the evaluators will be trained to identify satellite image patterns and correlate them with landscape units. These landscape units will reflect homogenous areas in relation to topography, land use or natural vegetation physiognomy, i.e. the “feeling-for-land”, that intuitively

the evaluators have acquired during their professional live. The extensive interviews and field trips showed that the intuitive and sometimes none organized knowledge the professionals constructed over several years of filed work, is usually very precise in predicting the limitations for the development of family agriculture. Ignore this expertise would be a mistake. The two field tests showed that the evaluators naturally divide an area according to factors that are related to the kind of land use that can be improved and within these units, according to limitation degrees. In most cases, the evaluator can not explain or describe this units using scientific terminology or clearly explain the reasons for dividing the area that way. This original division, which actually reflects the accumulated professional experience and the feeling for the best local land use versus landscape relation gets lost, when it is substituted to another that will fit the LCC as suggested in Normative Instruction 31 (INCRA/DF, 1999). Thus, the starting point of the land evaluation by SIATe is the none degraded expertise of the evaluator, expressed as a map dividing landscape units on a satellite image. During the measuring of the area by DGPS, soil sampling positions will be georeferenced, samples collected at the depths of 0-20 and 50-70 cm and soil morphological and slope aspects described for each mapping unit. The soil samples are send to a laboratory for chemical and physical analysis.

This procedure does not increase significantly the time and resources needed for field work, takes the advantage of the accumulated experience of the evaluator, operates quantitatively based on soil analysis and field observations and is georeferenced. The weaknesses are related to the subjectivity and intuitively used for the definition of the mapping units and the representatively of the soil samples. The more precise definitions and more structured organization of the LCC are not a guarantee that subjectivity will not occur during land evaluation. Focht (1998) identified the professional background and experience as the main reason for a poor coincidence when evaluating land using the LCC. Professionals with distinct experience resulted in evaluations only 20 % coincident. The best coincidences were among professionals with the same background and from the same region resulting in only 52 % of

coincidence. Thus, a wrong “feeling-for-land” will bring to a misevaluation in any case. Considering that subjectivity has to be accepted in expeditious land evaluation ignore or degrade a good “feeling-for-land” represents a precious and irrecoverable lost of information and quality. Do not take advantage of the accumulated professional experience, forcing the evaluators to fit their field observations into a system not designed to evaluate land for family agriculture is a inaccuracy inherent in Normative Instruction 31.

The Land Quality (LQ) module

The mean soil chemical and physical analytical results, soil morphological field observation and slope values for each mapping unit are introduced in SIATe. The complete set of variables to allow SIATe to calculate the Supply of Land Qualities (SLQ) are listed in table 1. These variables will be used for the definition of a qualitative value for 9 Land Qualities (LQ), listed in table 2, with exception of climate. Due to the importance of climate for none irrigated crop production, a special module for climate was developed based on the Thornthwaite-Mather method.

For all LQ the supply is defined qualitatively according to 5 restriction classes: i) not restricted (***nr***), ii) little restricted (***lr***), iii) moderately restricted (***mr***), iv) restricted (***r***) and v) very restricted (***vr***). The conversion of the descriptive or quantitative variables is processed internally and is based on decision trees. One example of a decision tree used for the definition of Current Nutrient Availability (CNA) is shown in table 3.

Table 1. Variables needed by SIATe to calculate Supply of Land Qualities (SLQ).

Soil analysis	Soil morphology	Slope
0-20 and 50-70 cm depth	0-20 and 50-70 cm depth	
CEC, base saturation, aluminum saturation, sodium saturation, electric conductivity, organic matter, clay content, silt content	Depth, stoniness, drainage, presence of stubs	Steepness

The decision trees were elaborated to reflect current knowledge about soil attributes and crop performance. A wide range of local bibliography (e.g. relative yield versus soil parameter curves, crop response curves to fertilizer addition, crop climatic zoning studies), expert consulting and observations during field work were used to support the decision trees. Eventually, these decision trees will have to be changed considering that most of the data used to elaborate them were obtained through research directed to commercial large scale farming. The change of a decision tree should be based on new knowledge or information or on the practical observation of its inadequacy. These changes should be carefully evaluated specially considering its effect on final land evaluation results. Thus, the SLQ module of SIATe can be considered as a relatively static module, with clear definitions on how physically based variables are converted to qualitative restriction classes and with clear instructions for procedures to collect data.

Table 2: Land Qualities (LQ) and Regional Conditions (RC) used in SIATe.

LQ	RC
Current Nutrient Availability	Cooperative Work
Capacity of Maintaining Nutrient Availability	Farmers Background
Nutrient Retention Capacity	Neighborhood
Rooting Conditions	Surroundings
Soil Water Holding Capacity	Accessibility Form
Soil Drainage	Accessibility Distance
Erosion Risk	Water Quality
Mechanization Capacity	Market
Climate	Initial Investments
	Loans
	Processing
	Technical Assistance
	Electricity Supply
	Irrigation

Table 3: Decision tree for the definition of the supply of Current Nutrient Availability

Base Saturation 0-20 cm	CEC 0-20 cm	OM 0-20 cm	Restriction
%	$mmol_c\ cm^{-3}$	$g\ kg^{-1}$	
>75	>50	>30	nr
>75	>50	10-30	nr
>75	>50	<10	lr
>75	0-50	>30	nr
>75	0-50	10-30	nr
>75	0-50	<10	lr
51-75	>50	>30	nr
51-75	>50	10-30	nr
51-75	>50	<10	lr
51-75	0-50	>30	lr
51-75	0-50	10-30	lr
51-75	0-50	<10	mr
30-50	>50	>30	mr
30-50	>50	10-30	r
30-50	>50	<10	vr
30-50	0-50	>30	r
30-50	0-50	10-30	r
30-50	0-50	<10	vr
<30	>50	>30	vr
<30	>50	10-30	vr
<30	>50	<10	vr
<30	0-50	>30	r
<30	0-50	10-30	r
<30	0-50	<10	vr

The Regional Conditions (RC) module

The quality of the land certainly is a key factor that will influence the improvement of family agriculture. Reasons for that are the immutability of most restrictions (e.g. a restriction for rooting conditions can not be amendment through management). Also, the low input in supplies and technology usually associated to the Brazilian AR agricultural systems, does not allow the adequate amendment of deficiencies in soil fertility or nutrient availability. Although, the interviews with settled farmers and extensionists and research results such as shown in Guanziroli et al. (1999) clearly point out that factors not related to soil or landscape properties may, and indeed do, influence significantly the development of a SP. These factors have a wide range of sources, but some of them were considered not to be specific for an isolated project or emerged due to a local and casual conjuncture. These factors, were named Regional

Conditions (RC) and are listed in table 1. The RC systematically impair or improve the development of SP, can be clearly defined and previously identified. Several factors that fit the definition of RC were not included in SIATe due to its low representatively, difficult definition or prediction. The RC module should be considered as complementary to the LQ module. The LQ module will evaluate if a specific area is suited for family agriculture or if permanent restrictions will impair its development. Complementarily, the RC module will evaluate if the AR is feasible at that moment. The variables that define the Supply of Regional Conditions (SRC) are more dynamic than for SLQ, reducing the temporal validity of an evaluation. Although, adequate feasibility conditions are more important at the beginning of the development of a SP, until the farmers could structure and improve the agricultural systems and get integrated to the local society. If favorable RC conditions change after some time, after the farmer has definitively established in the SP, the chances that he can adapt to worst conditions or change his agricultural system to fit in new reality are greater than starting from the beginning in a restrictive SRC scenario.

The current land evaluation procedure fail in considering only land quality aspects. Some evaluators are more sensitive to regional conditions and include an analysis of these aspects in the reports. Although, these analysis are not systematically organized, are not comparable to each other and, in most cases, do not reflect the majority of the influencing factors. The same way as for SLQ, the SRC are also defined according to 5 restriction classes. Different as for SLQ, where quantitative decision trees supports the decision, the SRC are conceptually described. As example, the concepts for the definition of restrictions for RC-Farmers Background and RC-Neighborhood were presented in table 4.

Table 4: Concepts for the definition of restrictions for the Supply of Regional Condition (SRC) Farmers Background and SRC- Neighborhood used in SIATe.

SRC-Farmers Background	**Restriction**
The farmers are familiar with the proposed land use. They developed the same activity in the same region as lessor or independent producer. The farmers are familiar with the production technology and the local commercial chains.	nr
The farmers are familiar with the proposed land use. They developed the same activity in another region as lessor or independent producer. The farmers will have to adapt to local production and commercial conditions.	lr
The farmers are familiar with the proposed land use. They developed the same activity as employees and are familiar only with production technology. They are not familiar with planning the activity and with commercial aspects.	mr
The farmers know similar agricultural systems but never developed the specific land use.	r
The proposed land use is completely unknown for the farmers.	vr
SRC-Neighborhood	
The neighborhood of the Settlement Project (SP) is composed of other SPs that improved and developed well and work in a cooperative and connected way.	nr
The neighborhood of the SP is composed of other recently created SPs that work in a cooperative and connected way.	lr
The neighborhood of the SP is not composed of other SP but tenure is similar composed of small farms based on family agriculture. No hostilities in relation to the SP are expected and the a cooperative and connected work between neighbors is feasible.	mr
The tenure around the SP is composed of large commercial farms. No hostilities in relation to the SP are expected. There is some possibility of integrated and cooperative work with the neighbors.	r
The tenure around the SP is composed of large commercial farms. Hostilities in relation to the SP are foreseen. There is no possibility of integrated and cooperative work with the neighbors.	vr

These definitions will also be linked to a decision criteria. But in this case, the sources of information an the condition each region will have to reach these definitions will be variable. Probably, in some cases, detailed economic analysis and social surveys will support the decisions and in other remote regions the opinion of the land evaluator will define most variables. Thus, the SRC can also be considered as a guide or a minimal set of variables, related to the regional context in which the SP will develop, that have to be defined the best possible way.

The analytical module

The qualitative levels of supplies of LQ and RC are first converted in quantitative variables. A linear increase, with 1 representing the most restricted condition (very restricted or ***vr***) up to 5 for the less restricted condition (not restricted or ***nr***) is used for this conversion. A percentage value is then calculated. The value of 100 % will represent a condition in which all supplies (SLQ or SRC) are equal the maximum value of 5, and a percentage of 0 % a condition in which all supplies are equal to 1. The same way as for supplies, the land uses suggested for a region, will demand LQ and RC. These demands were defined according to agronomic knowledge about crop performance and commercial or post harvesting treatments. These percentages are integrated indicators, useful to position the SP in relation to the intensity of land use and suitability for family agriculture. A low percentage value for SLQ or SRC will indicate low suitability or compatibility with land uses with low demands. The deviation between the supplies and demands are also presented as percentage positive or negative values, separately for LQ or RC. A negative deviation will indicate that the demands surpass the supplies resulting in a unsuited condition. A positive deviation will indicate that the supplies surpasses the demands of land use resulting in a suited condition with the possibility of improvement or intensification of land use. A deviation close or equal to zero will indicate a suited condition but with low possibility of intensification.

For each suited condition, the analytical module will provide information about expected income, spare capacity and the value for acquiring the

area in accordance to a size of division. With this information the evaluator can objectively and quantitatively decide on the number of families to be settled, preserving a target income and spare capacity as well as the maximum resources the Union should spend for the area. This feasibility analysis is also important to characterize the current unproductive status of the area.

The reports provided by SIATe have a standard format and are automatically generated. The advantage of this procedure is the less time needed for office work, to compensate the filed work that has been increased. Another advantage is to easier understand and compare the evaluations. This is important due to the fact that the final decision on acquiring land for AR is taken directly by the Minister.

Another feature of SIATe is a module that converts the percentage values generated for SLQ in Land Capability Classes. This module was developed for practical reasons. The LCC is the currently accepted land evaluation system and in most cases considered as a synonym for land evaluation, especially in legal instances. The percentage approach of SIATe and the consideration of variables not related to land qualities may cause confusion and misunderstanding. These correlation or conversion module should help to reduce this problem by generating a comparable result in a more traditional system.

Conclusions

SIATe is a land evaluation expert system designed specifically for the Brazilian agrarian reform.

This specific design will allow more precise and objective land evaluation without increasing the need or skill for human or financial resources.

SAITe objectively considers physically based variables (Land Qualities) and the regional economic and social condition (Regional Conditions). These more comprehensive approach as compare to the current methods, will reduce misevaluation problems.

Misevaluation problems frequently impair the development of the settlement projects or result in legal obstruction of the agrarian reform process.

References

Becket, P.H.T., Bie, S.W. (1978) Use of soil and land-system maps to provide soil information in Australia. Division of soil technical paper No 33, CSIRO.

Diepen, C.A., Keulen, H., Wolf, J., Berkhout, A.A. (1991) Land Evaluation: from intuition to quantification. Advances in Soil Science, New York, 15:140-204.

FAO (1976) A framework for land evaluation. Soils Bulletin 32. Food and Agriculture Organization of the United Nations, Rome. 72 pp.

Focht, D. (1998) Influência do avaliador no resultado da classificação de terras em Capacidade de Uso. M.Sc. Thesis, University of São Paulo, Piracicaba, 110 pp.

Gasques, J.G., Verde, C.M.V. (1998) Trinta anos de dispêndios da União com política fundiária (INCRA/FAO), 60 pp.

Guanziroli, C. (1999) Reforma agrária e globalização da economia – o caso do Brasil (INCRA/FAO), 26 pp.

Guanziroli, C., Bittencourt, G.A., Castilhos, D.S.B de, Bianchini, V., Silva, H.B.C da. (1999) Principais fatores que afetam o desenvolvimento dos assentamentos de reforma agrária no Brasil. INCRA/FAO, 62 pp.

INCRA (200) Balanço 1999 – Reforma agrária e agricultura familiar, 50 pp.

INCRA/DF (1999) - Sistemática de Desapropriação por Interesse Social. Instrução Normativa No 31.

Klingebiel, A. A., Montgomery, P. H. (1961) Land - Capability classification. Washington: USDA, Soil conservation Service, 21p. (USDA. Handbook, 210).