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Agricultural Development Support II Project

A GIS ATLAS OF THE DEPARTEMENT DU SUD: COMPARISONS OF STRATA IN THE NATIONAL AGRICULTURAL SURVEY

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A GIS ATLAS OF THE DEPARTMENT DU SUD: COMPARISONS OF STRATA IN THE NATIONAL AGRICULTURAL SURVEY

I. INTRODUCTION

An area's natural resource base defines the possiblities and imposes limits on agricultural activities. Information concerning the pattern and extent of agricultural activities in the Departement du Sud has become available from the ADS-II (Agricultural Development Support Project-II) National Agricultural Survey (see, for example, ADS-II Reports Nos. 15, 22, 24). The survey utilizes an open-segment area frame methodology to obtain estimates of crop areas and yields, animal numbers and related socio-economic variables associated with agricultural households. The survey was begun during the second agricultural season of 1985 and is currently expanding to the national level.

The distinct levels of agricultural activities delimited by strata for the national survey should be highly correlated with the natural resource base of the area. Comparing and contrasting strata in terms of their underlying resource base is one method of testing the efficacy of the the stratification effort. This paper demonstrates how a GIS (Geographic Information System) may be used to analyze and evaluate the national survey stratification scheme.

The stratification scheme used for the national survey relies upon aerial photographic interpretation and delineation of up to seven strata within each department. These strata are described in Table 1. The delineation of strata for the survey depends upon the stratifier's skill, his interpretation of the definitions and the existence of identifiable and usable boundaries which coincide with the spatial limits of each strata. The resultant strata also depend indirectly upon the underlying resource base of the area since this base will manifest itself through the different agricultural activities interpreted by the stratifier.

From a technical point of view, the degree of homogeneity within strata and the differences between strata are crucial for assessing the efficacy of the stratification scheme. Ceteris paribus, the greater the degree of homogeneity within individual stratum and the greater the differences between stratum, the more efficient is the stratification scheme. The major problem in assessing the technical efficacy of any stratification scheme used in a sampling frame is that alternative schemes need to be developed, tested and compared. For example, the best method of assessing intra-stratum homogeneity involves comparing stratum-level CV (coefficient of variation) statistics for key variables derived from alternative stratification schemes. However, in cases where resources are extremely limited, it is simply not feasible to simultaneously develop two or more frames based on different stratification schemes to make the needed comparisons.

Nevertheless, some limited analyses can be done to assess indirectly the efficacy of the stratification scheme used for any given frame. For example, based on the statistical results of the survey, decisions to drop or add replicates in any stratum or to collapse stratum into larger stratum can be made and tested during future surveys. In this manner, the efficiency of the frame based on the existing stratification scheme can be tested and incrementally improved over time. Both of these alternatives have been utilized during the frame development in Haiti.

Another method, used in this paper, involves comparing and contrasting the strata in terms of the underlying resource base of the area. The ADS-II Comprehensive Resource Inventory and Evaluation System (CRIES)GIS data base is uniquely appropriate for this type of analysis. It provides a fast, accurate and versatile means of rapidly summarizing spatially referenced information. Besides allowing for comparisons of resources within and among strata, the GIS information should help the user to better understand and interpret the survey information already reported elsewhere.

The GIS information below is presented for the entire department and also for each stratum, thus facilitating inter-stratum comparisons and contrasts. A subset of the current GIS data was selected for this analysis, including; land use, Holdridge Life Zones, soil potential, elevation, slope, and aspect. Also, since the village and water strata of the national survey are spatially very small, they were not included in the analysis presented in this report.

The user should be aware that although the picture of the resource base that evolves from the anlysis for each stratum is representative of the land area within each stratum, the survey information results from an open segment area frame methodology. Consequently, at the stratum level, the survey information is representative of the agricultural households <u>residing</u> within the stratum, irregardless of where they may have their land or animals. Although most farmers do carry on their agricultural activities near their residence, the GIS and survey stratum definitions are not strictly consistent.

The methodology used to develop and delimit the strata has been discussed in ADS-II Report #21. The development of the GIS data base is described in ADS-II Report #17, with a detailed example of it's application given in ADS-II Report #25.

II. DESCRIPTION OF THE NATURAL RESOURCE DATA BASE

The following section describes the GIS data base that was used in this analysis, including the source of the original data for each GIS information layer (attribute). Tables are presented for each information layer giving the numeric codes used with a description of each code (see Liste des Tableaux, page ii). These numeric codes should be used to interpret the sequence of graphs that follow giving the relative distribution of each attribute for the department, and then for each strata (see Liste des Figures, page iii). Each information layer is then displayed as a map for the entire department (see Liste des Cartes, page iv).

National Survey Strata: The strata for the national survey were originally delimited on aerial photography before being transferred to 1:50,000 scale topographic maps. The information for the Departement du Sud was digitized from the topographic maps and entered into the GIS. Table 1 presents the codes and general descriptions of the survey strata. Figure 1 shows the relative distribution of the various strata within the department. Map 1 shows the strata for the entire department.

Occupation de L'espace: The information provided was digitized from the 1:250,000 thematic map developed by the French firm BDPA in 1982. A description of the categories is given in Table 2, followed by a graphic illustration of relative occurance of categories for the department (Figure 2a) and for each strata (Figures 4a, 5a, 6a, and 7a). For easier visual comprehension, the original 51 categories have been collapsed into six strata for the map appearing on page 25.

Holdridge Life Zones: The Holdridge zones were digitized from the 1:250,000 OAS (Organization of American States) map produced in 1972. A description of the Holdridge codes is presented in Table 3. The same exposition sequence of graphics and map follow.

Potentialite des Sols: The information presented was digitized from the 1:250,000 BDPA map published in 1982. A description of soil potential categories is presented in Table 4 followed by the same sequence of graphics and map. To facilitate visual comprehension, the original 19 categories have been collapsed into 6 strata for the soil potential map on page 27.

Elevation: The information presented was digitized from the 1:50,000 topographic maps. The elevation codes are given in Table 5. The same exposition sequence of graphics and map follow.

Slope: The slope information was computed from the elevation data using the CRIES-GIS software. The slope classes are given in Table 6. The same exposition sequence of graphics and map follow.

Aspect: The aspect information was also computed from the elevation data using the CRIES-GIS software. The aspect classes are given in Table 7. The same exposition sequence of graphics and map follow.

III. DISCUSSION

Given the information shown in the figures and tables described above, the efficacy of the stratification effort can be evaluated using the GIS software. The following discussion summarizes the information within each stratum for each of the GIS data layers.

Within the plaine intensive stratum, land use is dominated by intensive agriculture (43%) with some monocultures of rice (10%) and sisal (10%). The soil potential is mostly good to excellent (59%) or average (31%). The Holdridge classification is predominantly humid, subtropical forest (75%) with some dry, subtropical forest (23%). 96% of this stratum has an elevation of 200 meters or less and 88% has a slope of 8% or less. 68% of the land area is flat (no aspect). The information corresponds well with the stratum definition (see Table 1), intensive agriculture in low lying or flat areas.

Within the plaine extensive stratum, the land cover is dominated by average-intensity agriculture and brushlands (41%) with more mixtures of tree categories. The soil potential is poorer than the plaine intensive class with 40% good to excellent, 10% average, and 49% in the poor category. The Holdridge life zones are divided between the very humid, subtropical forest (45%) and the dry, subtropical forest (41%). The elevation classes are divided into two groups, one group below 80m on the low plains and the other group between 500 and 1000m, corresponding to plateau regions in the upper mountain areas. 63% of this stratum has slopes less than 12% with an even mixture of aspects. This profile seems consistent with the extensive plain description in Table 1.

The montagne intensive strata shows land cover mixed between the intensive agriculture (29%) and tree-dominated crops (27%). The soil potential is poorer than either of the plaine strata, having 72% falling within the poor soil potential classifications. The range of elevations and slopes are much greater than the plaine strata, with 84% between 100 and 500m elevation, and 29% with slopes between 15 and 50%. 25% has no aspect while the rest of the aspects are evenly distributed. The Holdridge classification is mostly humid, subtropical forest (54%) or very, humid subtropical forest (32%). The profile is consistent with the description in Table 1.

The montagne extensive stratum shows more of a mixture in the land cover categories, the elevation ranges, and in the Holdridge classifications. 22% of this stratum demonstrates average or low intensity agriculture and 17% tree-dominated crops. The slopes are definitely steeper than in the montagne intensive stratum with 25% greater than 50% slope and another 40% between 20 and 50% slope. The soil potential falls mostly in the poor category (86%). This is the only strata with a substantial area over 1000 meters in elevation (17%). This mixture of cover classes, high elevations, extremely steep slopes, and poor soil conditions lend evidence to the extensive nature of this particular stratum. Field observations have shown that some segments in this stratum are difficult to locate and practically in-accessible, due to the complex terrain conditions and lack of access roads.

IV. CONCLUSIONS

This report presented an analysis of the national survey strata using the geographic information system. The two systems complement each other very well. The survey strata represent spatial information which can be easily entered into the GIS. The GIS provides the capability to independently analyze the efficacy of the survey stratification scheme using the resource-base variables resident within the GIS data base.

The analysis of the survey strata revealed consistent trends and patterns between strata. For example, the analysis indicated a trend in soil potential from higher percentages of good and excellent soils in the intensive strat to poorer soils in the extensive strata. The GIS strata profiles were also consistent in terms of the elevation, slope, aspect and land use classes and seemed to follow closely the original criteria for stratification. The Holdridge Life Zones appear to be too general a classification scheme for comparisons at the strata level.

The results of this analysis can serve as base-line information for similar analyses in other departments in the future. Since a good correlation between the resource base and the strata exist in this department, the strata profiles may represent a more objective and cost-effective means to evaluate and rate the stratification efforts elsewhere, indicating where changes should be made.

Tableau 1.

STRATA OF THE NATIONAL AGRICULTURAL SURVEY
Departement du Sud

Code	Description
10	PLAINE INTENSIVE : Basically crop production areas of very intense agriculture in low lying or flat areas. Cultivated areas are 50 percent or more for the stratified area and dispersed uniformly.
15	PLAINE EXTENSIVE : Crop production areas in low lying or flat areas with agricultural intensity less than 50 percent. Fields are more scattered.
20	MONTAGNE INTENSIVE : Very intense crop production areas located in mountain areas. Cultivated areas are 50 percent or more for the strata. (Same as strata 10, except in mountains).
25	MONTAGNE EXTENSIVE : Crop production areas in the mountains with less than 50 percent of the area having cultivation present. Fields are more scattered.
32	URBAN/VILLAGE : Urban area surrounding and including villages. High population density. Not included in this report.
60	WATER : Water areas greater than 1 sq. km. Not included in this report.

Tableau 2.
Occupation De L'Espace

Codes du Classification	Description
1	Lacs et Rivieres
2	Riz
3	Canne a Sucre
4	Cultures Annuelles Irriguees
5	Banane
6	Sisal
7	Vetyver
8	Cocotier
9	Cultures Arborees Dominates
10	Cultures Arborees Claires
11	Cultures Vivrieres Denses
12	Cultures Vivrieres Moyennement Denses
13	Cultures Vivrieres Dispersees
14	Pasturage Extensifs Dominants
15	Rack Bois
16	Savanes Arbustives Denses
17	Savanes Arbustives Claires
18	Savanes Arbustives Tres Claires
19	Feuillus Denses
20	Feuillus Clairs
21	Feuillus Tres Clairs
22	Pins Denses
23	Pins Clairs
24	Pins Tres Clairs
25	Salins
26	Lits De Rivieres, Alluvions Grossieres
27	Zones Steriles De Bord De Mer, Sols a Nu
28	Afflevrements Rocheux
29	Mangroves Ou Marais
30	Cultures Arborees Dominates et Feuillus Tres Clairs
31	Ville
32	Cultures Arborees Dominates et Feuillus Clairs
33	Cultures Arborees Claires et Feuillus Tres Claires
34	Cultures Arborees Claires et Pasturage Extensifs Dominants
35	Cultures Arborees Claires et Cultures Vivrieres Dispersees
36	Cultures Vivrieres Moyennement Denses et Savanes Arbustives Tres Claires
37	Cultures Vivrieres Moyennement Denses et Zones Steriles De Bord De Mer, Sols a Nu
38	Cultures Vivrieres Moyennement Denses et Rack Bois
39	Cultures Vivrieres Dispersees et Rack Bois
40	Cultures Vivrieres Dispersees et Feuillus Clairs
41	Cultures Vivrieres Dispersees et Feuillus Tres Clairs
42	Cultures Vivrieres Dispersees et Savanes Arbustives Tres Clairs
43	Cultures Arborees Claires et Feuillus Clairs
44	Cultures Vivrieres Moyennement Denses et Pins Tres Clairs
45	Cultures Vivrieres Moyennement Denses et Savanes Arbustives Clairs
46	Cultures Vivrieres Moyennement Denses et Pins Tres Clairs
47	Savanes Arbustives Denses et Feuillus Tres Clairs
48	Feuillus Clairs et Pins Clairs
49	Cultures Arborees Claires et Savanes Arbustives Clairs
50	Cultures Vivrieres Denses et Savanes Arbustives Clairs
51	Cultures Vivrieres Dispersees et Savanes Arbustives Clairs
52	Sans Classification

Tableau 3.
Classification Agro-Ecologique De Holdridge
Departement du Sud

Codes du Classification	Description
1	Haute altitude, zone montagneuse très humide. Plus de 2000 mètres, forêts de pins.
2	Basse altitude, zone montagneuse, forestière, pluviale.
3	Basse altitude, zone montagneuse, forestière, pluviale 800 - 2000 mètres.
4	Basse altitude, zone montagneuse, humide, forestière entre 800 et 2000 mètres.
5	Zone forestière, pluviale, sous-tropicale.
6	Très humide, zone forestière sous-tropicale.
7	Humide, zone forestière sous-tropicale.
8	Forêt sèeche, sous-tropicale, basse altitude, gènèralement au-dessous de 400 mètre. Diverses variètes de cactus.
9	Tempête sous-tropicale, zone forestière. Partie très restreinte et la plus aride du pays. Prés de Gonaives.

Tableau 4.
Potentialite Des Sols

Codes du Classification	Description
1	Lacs et Rivieres
2	Excellentes
3	Tres Bonnes
4	Bonnes
5	Moyennes
6	Mediocres
7	Faibles (Erodes)
8	Faibles (Inondables)
9	Limitees (Erodables)
10	Limitees (Sols Salins)
11	Tres Limitees (Forets)
12	Tres Limitees (Sols Salins)
13	Tres Limitees (Rocheux)
14	Excellentes (Plaines)
15	Moyennes (Marecages)
16	Excellentes (Marecages)
17	Tres Bonnes (Collines)
18	Urbaine
19	Sans Classification

Tableau 6.

Altitude
Departement du Sud

Codes du Classification	Description (metres)
2	< 20
3	20 - 40
4	40 - 60
5	60 - 80
6	80 - 100
7	100 - 200
8	200 - 300
9	300 - 400
10	400 - 500
11	500 - 600
12	600 - 700
13	700 - 800
14	800 - 900
15	900 - 1000
16	1000 - 1100
17	1100 - 1200
18	1200 - 1300
19	1300 - 1400
20	1400 - 1500
21	1500 - 1600
22	1600 - 1700
23	1700 - 1800
24	1800 - 1900
25	1900 - 2000
26	2000 - 2100
27	2100 - 2200
28	2200 - 2300
29	Sans Classification

Tableau 6.

PENTES
Departement du Sud

Codes du Classification	Description (% slope)
1	0 - 3.9
2	4 - 7.9
3	8 - 11.9
4	12 - 14.9
5	15 - 19.9
6	20 - 29.9
7	30 - 49.9
8	> 50
9	Sans Classification

Tableau 7.

PENTES A ORIENTATION VARIEES (ASPECT)
Departement du Sud

Codes du Classification	Description (Orientation)
1	Nord
2	Nord-est
3	Est
4	Sud-est
5	Sud
6	Sud-ouest
7	Ouest
8	Nord-ouest
9	Pas d'exposition
10	Sans Classification

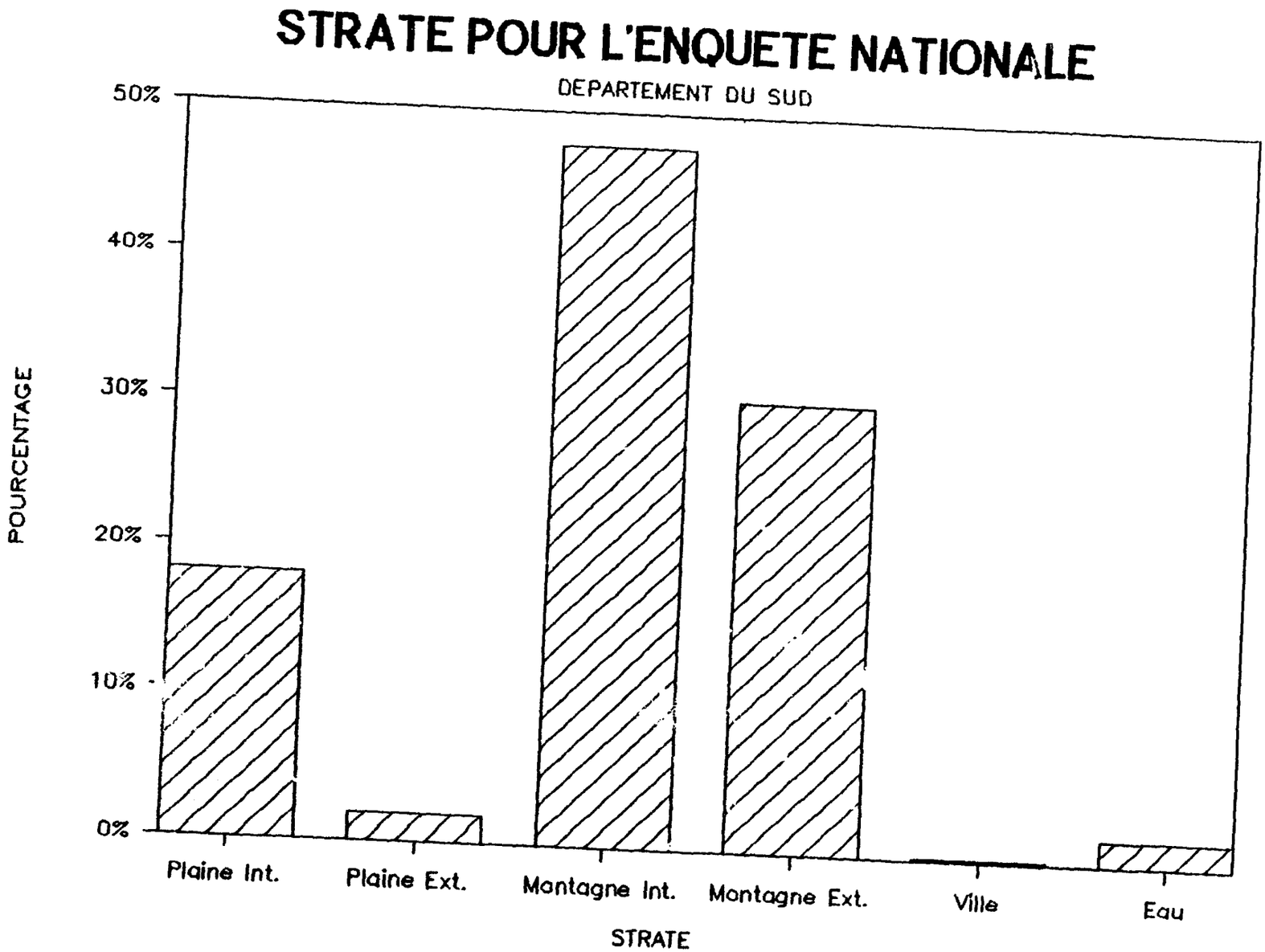
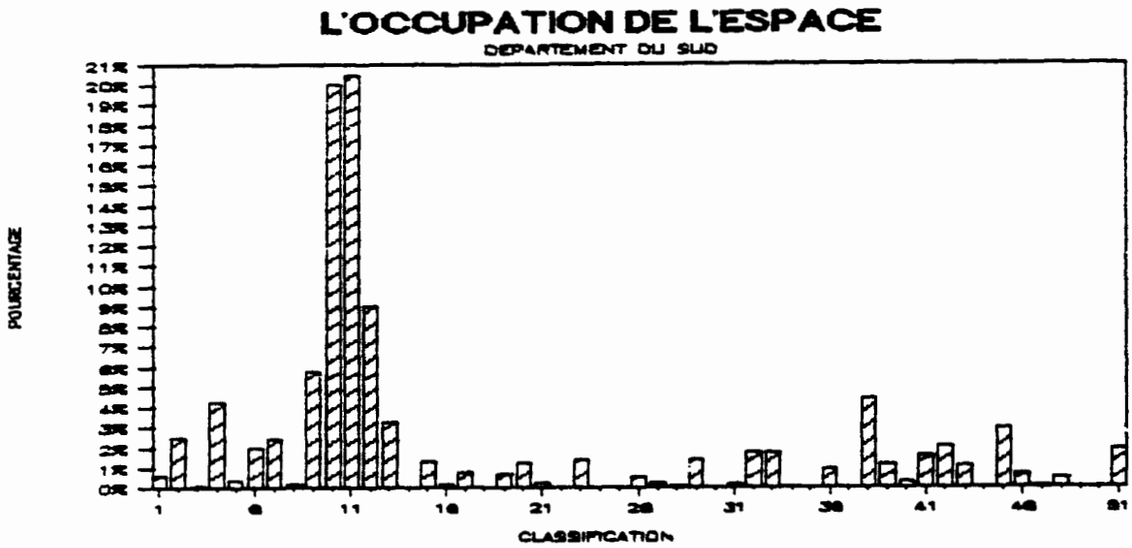
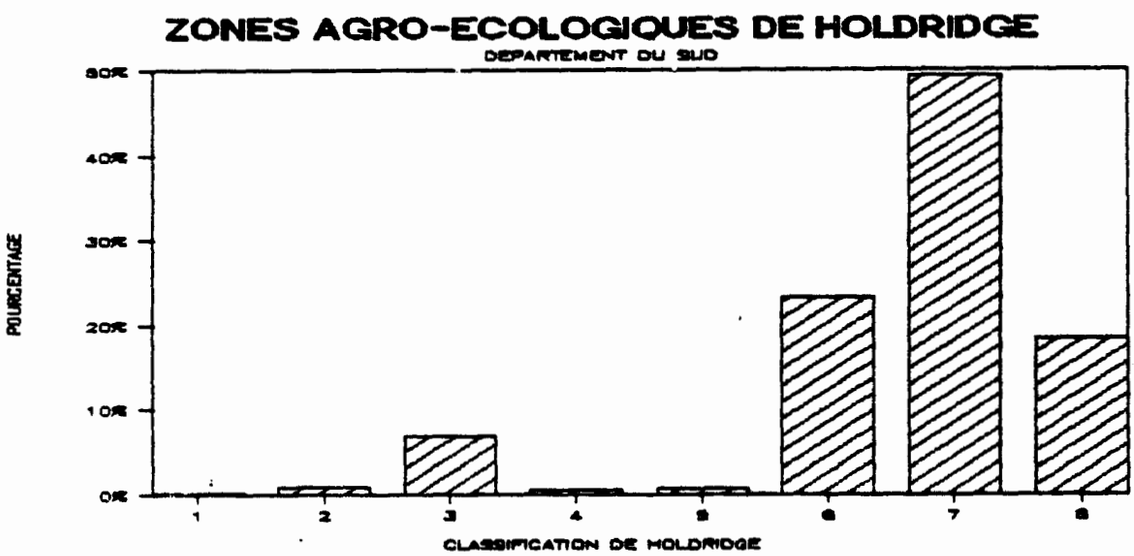

STRATE POUR L'ENQUETE NATIONALE
DEPARTEMENT DU SUD
POURCENTAGE
50%
40%
30%
20%
10%
0%
Plaine Int.
Plaine Ext.
Montagne Int.
Montagne Ext.
Ville
Eau
STRATE

Figure 1.

Figure 2. (a)


L'OCCUPATION DE L'ESPACE
DEPARTEMENT DU SUD
POURCENTAGE
CLASSIFICATION

(b)


ZONES AGRO-ECOLOGIQUES DE HOLDRIDGE
DEPARTEMENT DU SUD
POURCENTAGE
CLASSIFICATION DE HOLDRIDGE

(c)

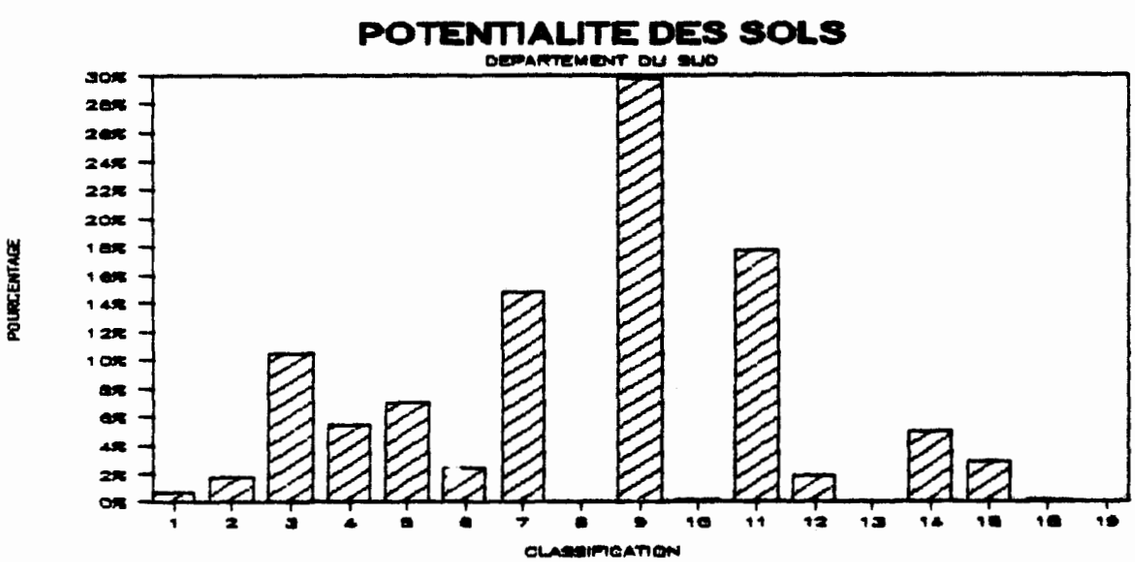
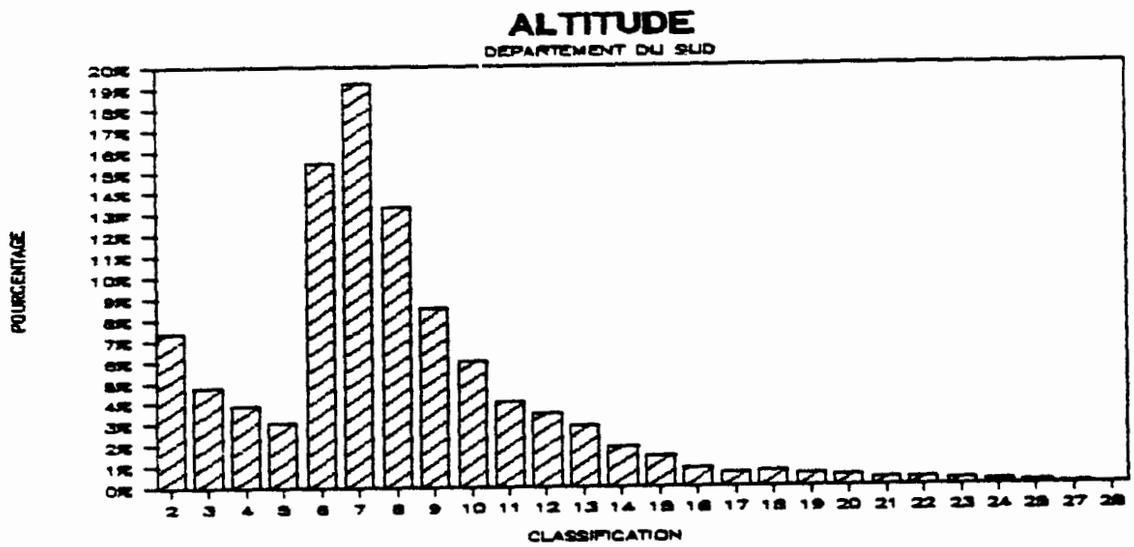
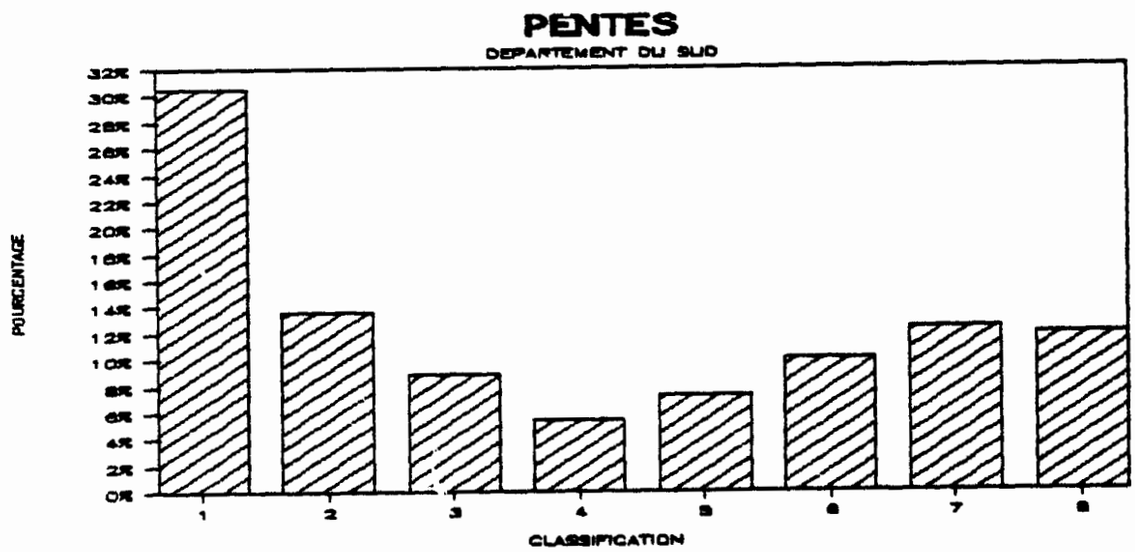

POTENTIALITE DES SOLS
DEPARTEMENT DU SUD
POURCENTAGE
CLASSIFICATION

Figure 3. (a)


ALTITUDE
DEPARTEMENT DU SUD
POURCENTAGE
CLASSIFICATION

(b)


PENTES
DEPARTEMENT DU SUD
POURCENTAGE
CLASSIFICATION

(c)

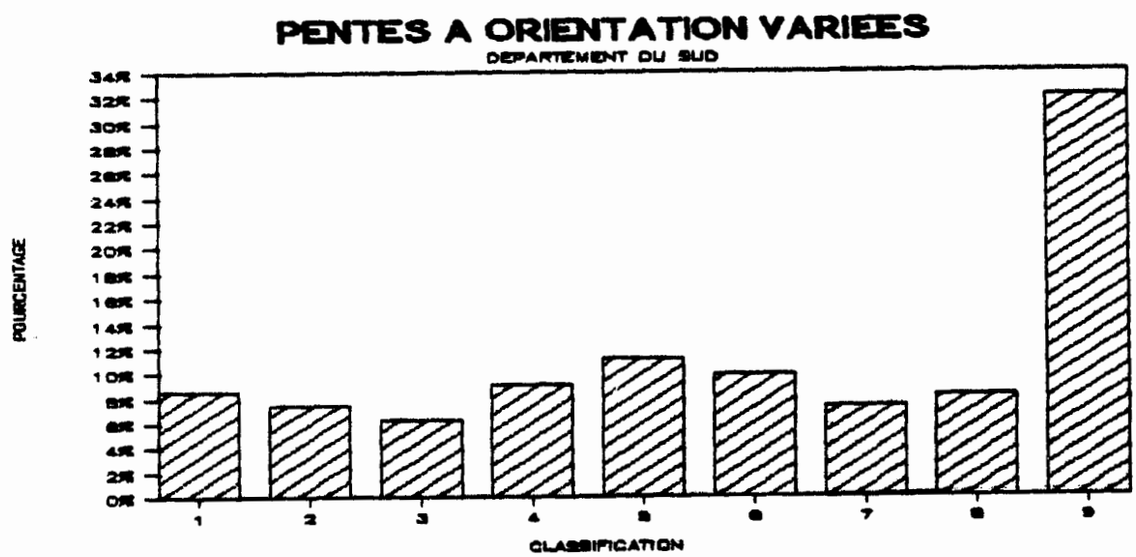
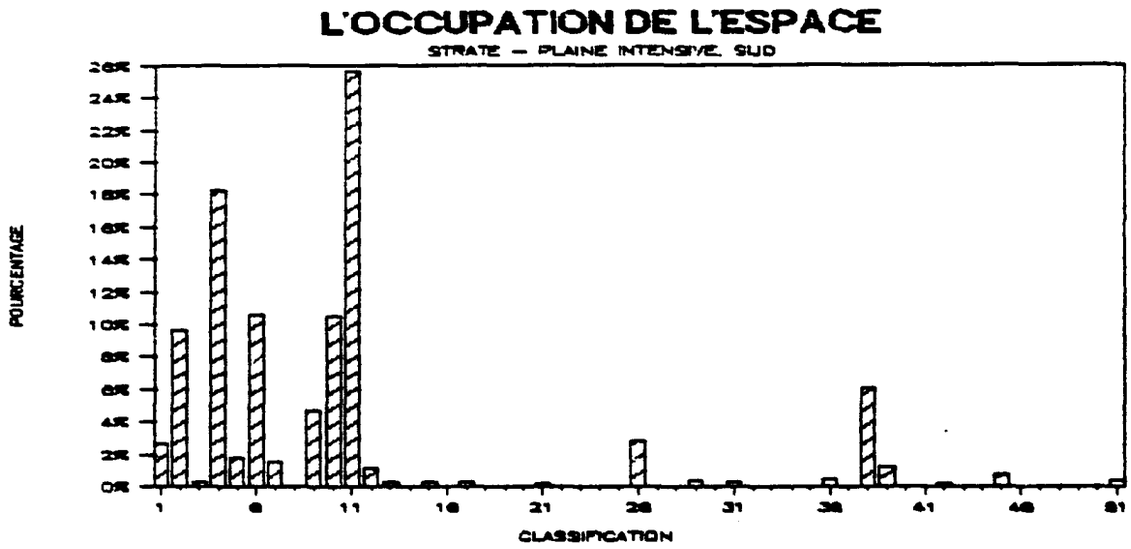
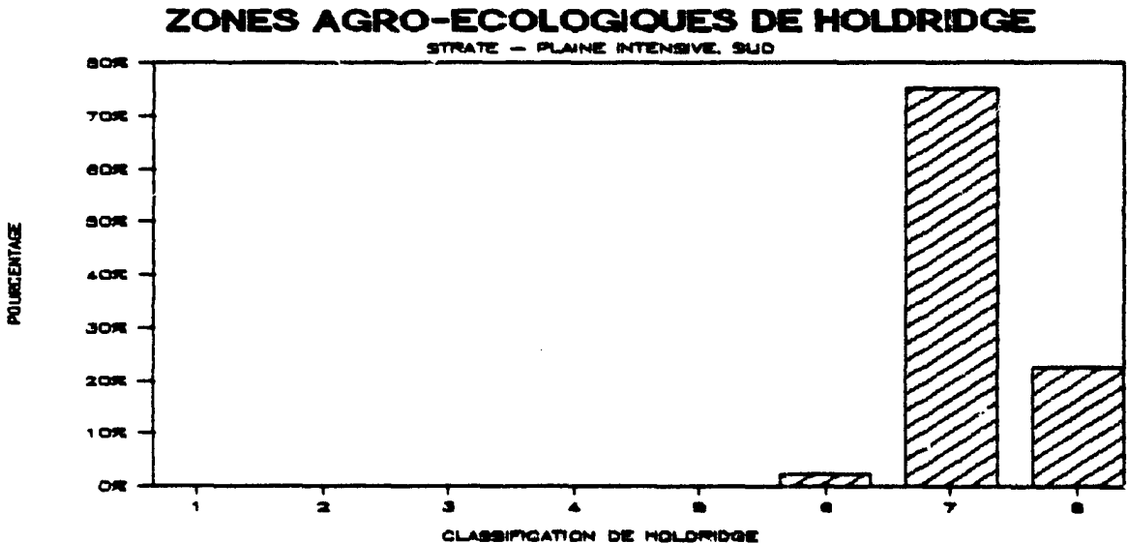

PENTES A ORIENTATION VARIEES
DEPARTEMENT DU SUD
POURCENTAGE
CLASSIFICATION

Figure 4. (a)


L'OCCUPATION DE L'ESPACE
STRATE — PLAINE INTENSIVE, SUD
POURCENTAGE
CLASSIFICATION

(b)


ZONES AGRO-ECOLOGIQUES DE HOLDRIDGE
STRATE — PLAINE INTENSIVE, SUD
POURCENTAGE
CLASSIFICATION DE HOLDRIDGE

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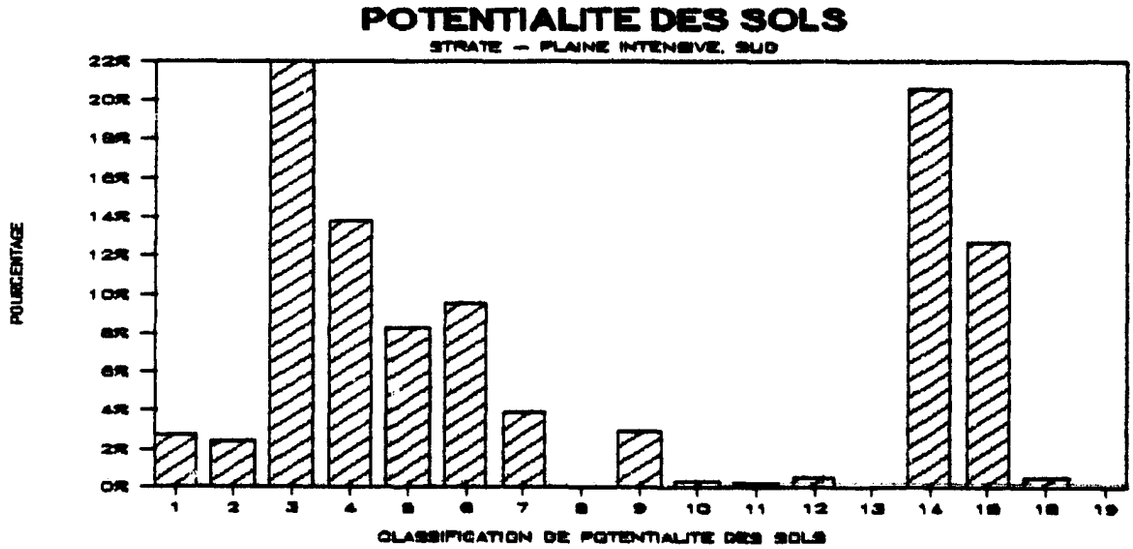
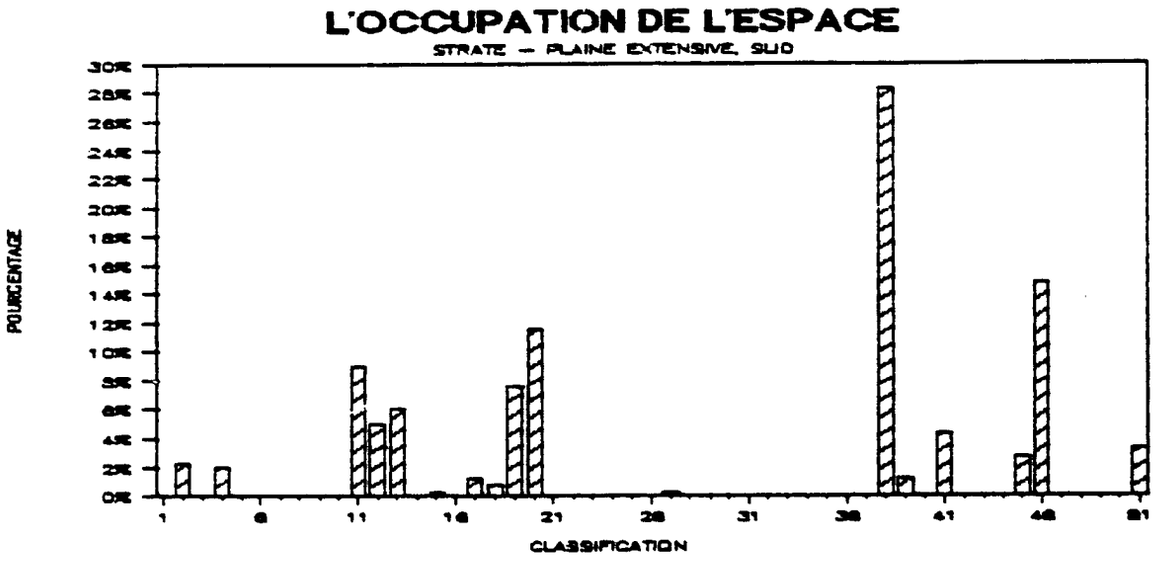
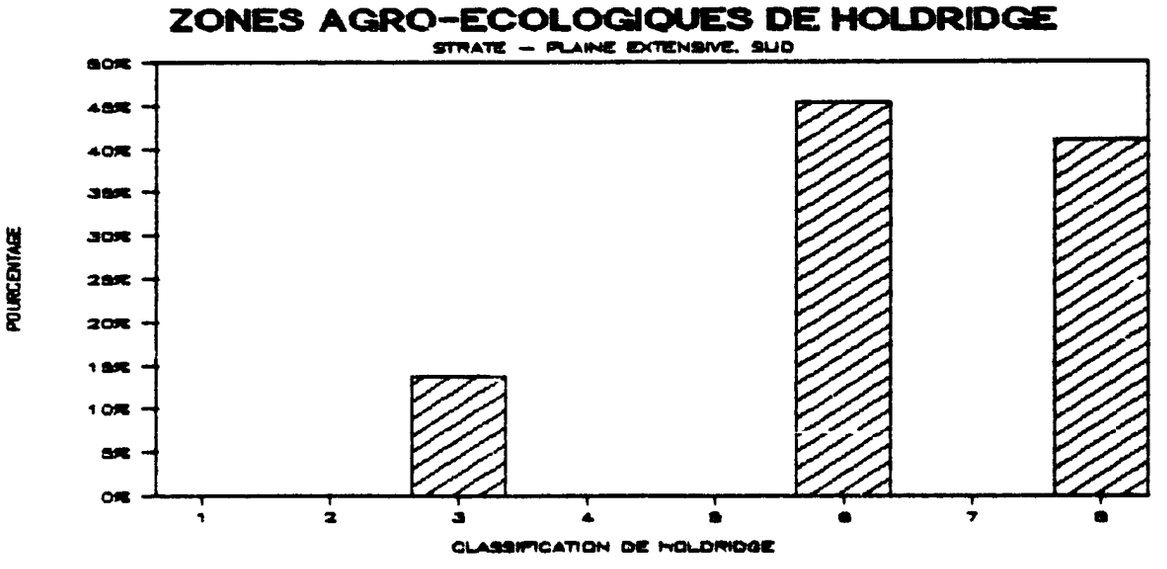

POTENTIALITE DES SOLS
STRATE — PLAINE INTENSIVE, SUD
POURCENTAGE
CLASSIFICATION DE POTENTIALITE DES SOLS

Figure 5. (a)


L'OCCUPATION DE L'ESPACE
STRATE — PLAINE EXTENSIVE, SUD
POURCENTAGE
CLASSIFICATION

(b)


ZONES AGRO-ECOLOGIQUES DE HOLDRIDGE
STRATE — PLAINE EXTENSIVE, SUD
POURCENTAGE
CLASSIFICATION DE HOLDRIDGE

(c)

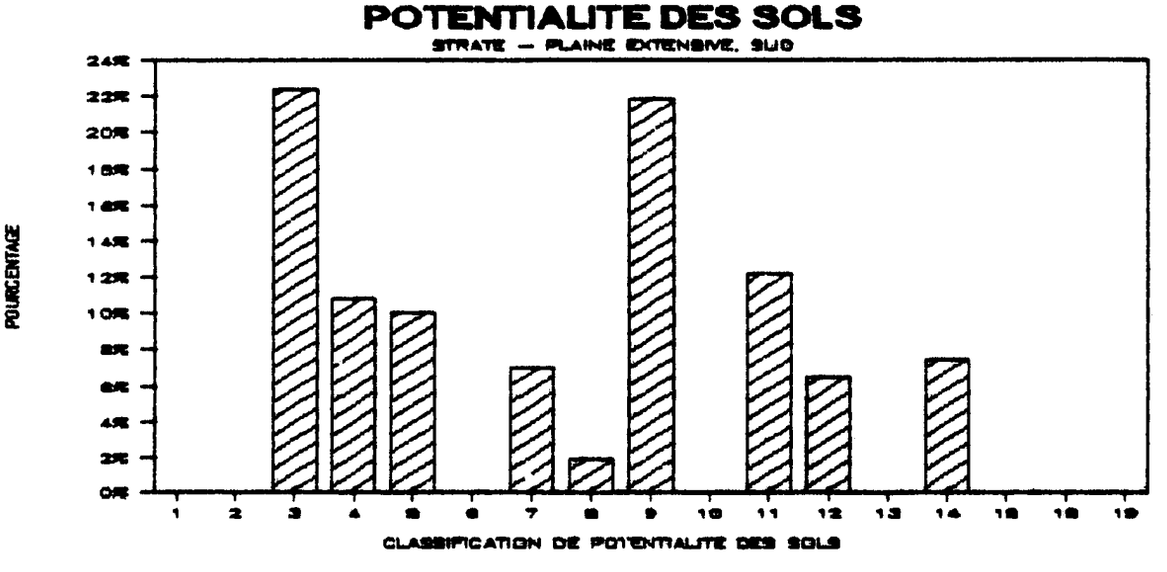
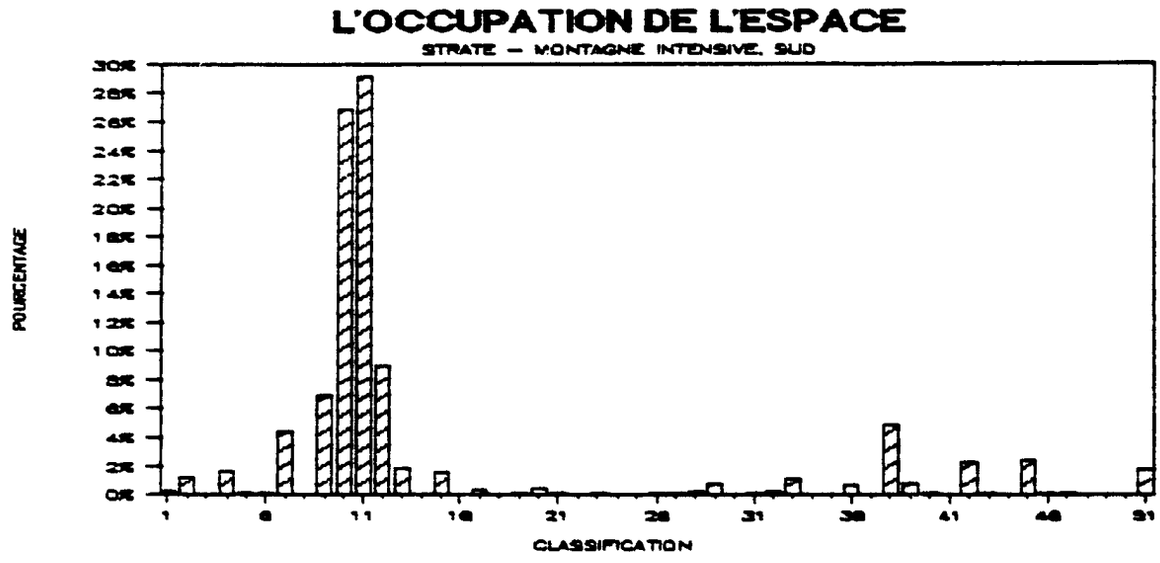
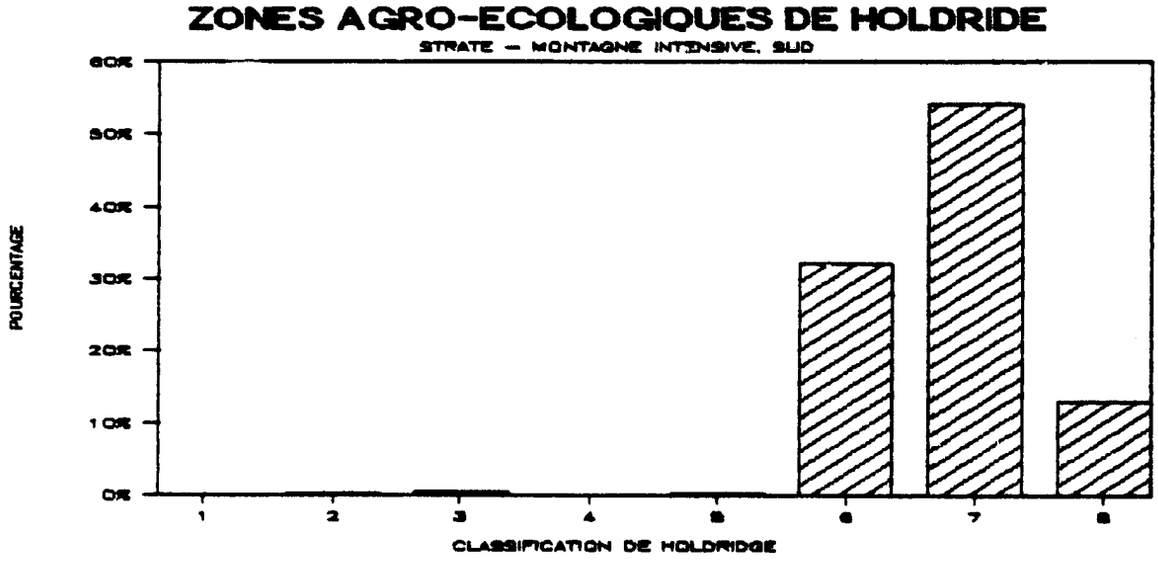

POTENTIALITE DES SOLS
STRATE — PLAINE EXTENSIVE, SUD
POURCENTAGE
CLASSIFICATION DE POTENTIALITE DES SOLS

Figure 6. (a)


L'OCCUPATION DE L'ESPACE
STRATE — MONTAGNE INTENSIVE, SUD
POURCENTAGE
CLASSIFICATION

(b)


ZONES AGRO-ECOLOGIQUES DE HOLDRIDE
STRATE — MONTAGNE INTENSIVE, SUD
POURCENTAGE
CLASSIFICATION DE HOLDRIDGE

(c)

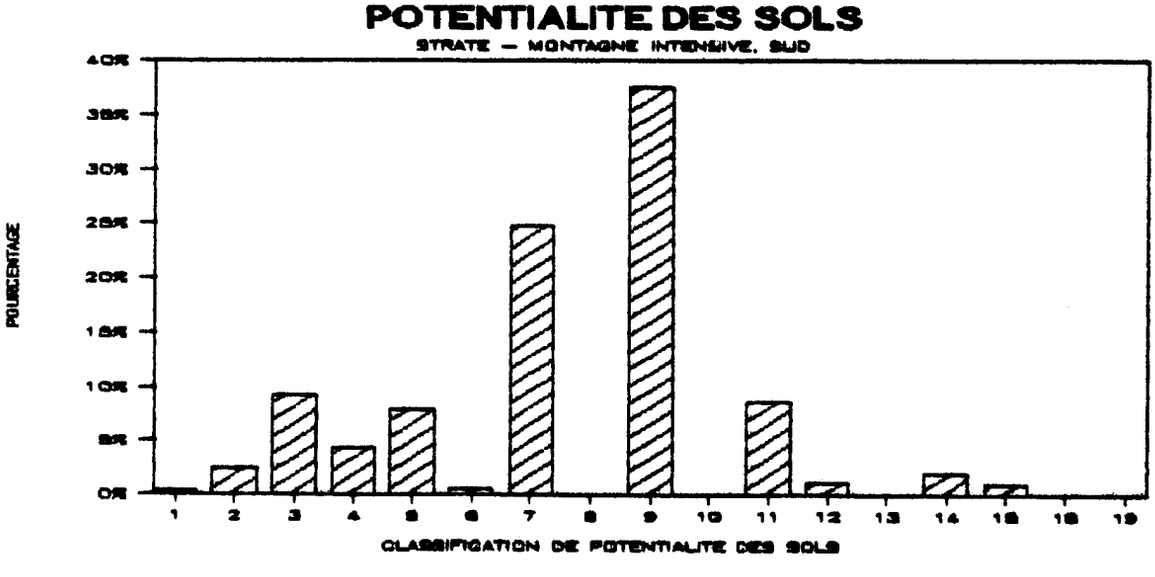
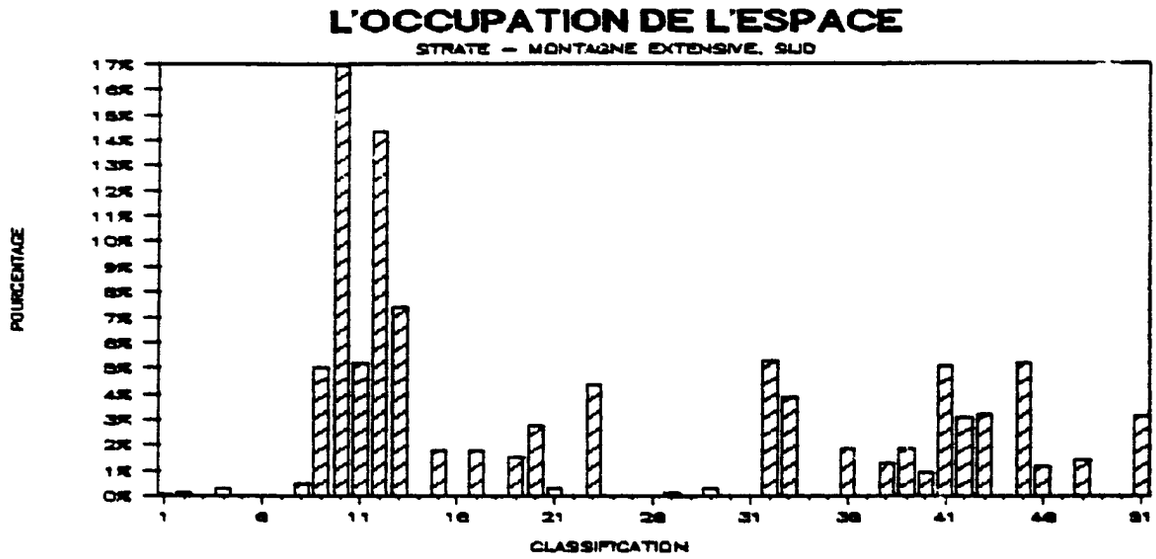
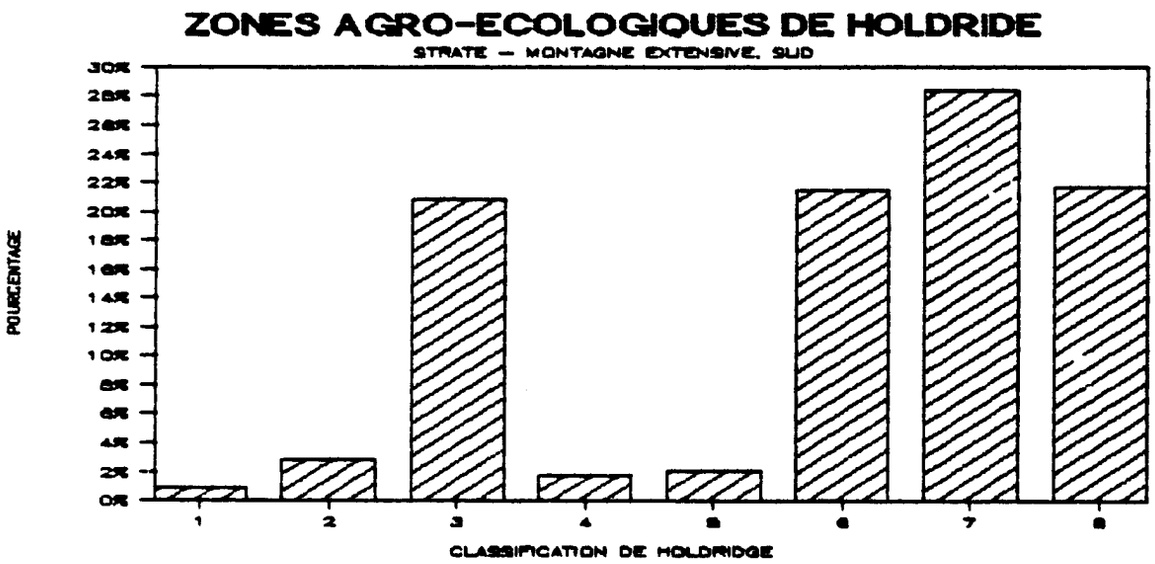

POTENTIALITE DES SOLS
STRATE — MONTAGNE INTENSIVE, SUD
POURCENTAGE
CLASSIFICATION DE POTENTIALITE DES SOLS

Figure 7. (a)


L'OCCUPATION DE L'ESPACE
STRATE — MONTAGNE EXTENSIVE, SUD
POURCENTAGE
CLASSIFICATION

(b)


ZONES AGRO-ECOLOGIQUES DE HOLDRIDE
STRATE — MONTAGNE EXTENSIVE, SUD
POURCENTAGE
CLASSIFICATION DE HOLDRIDGE

(c)

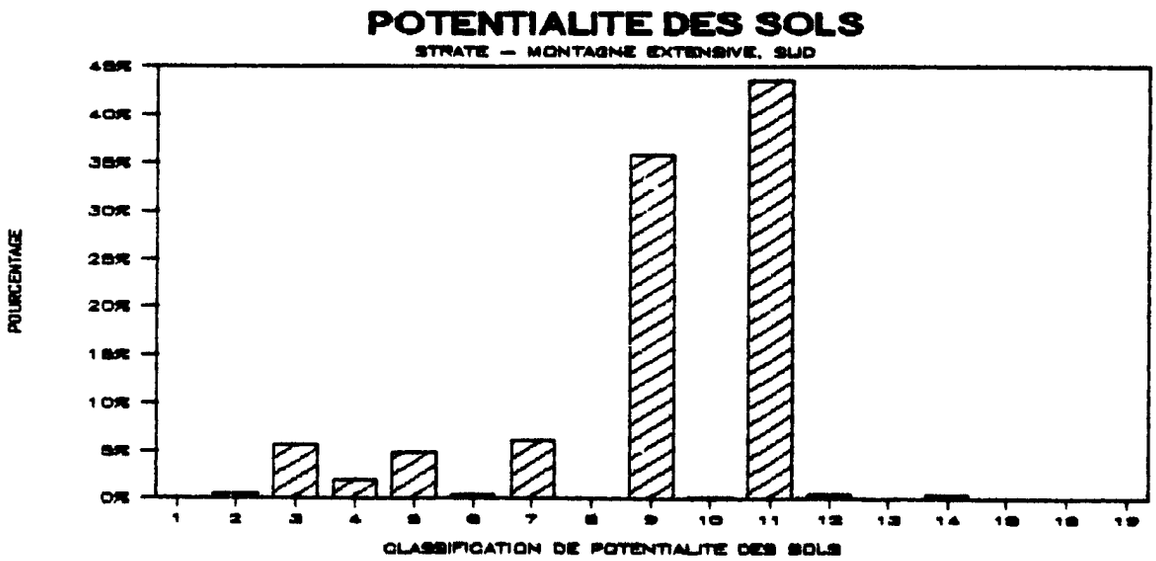
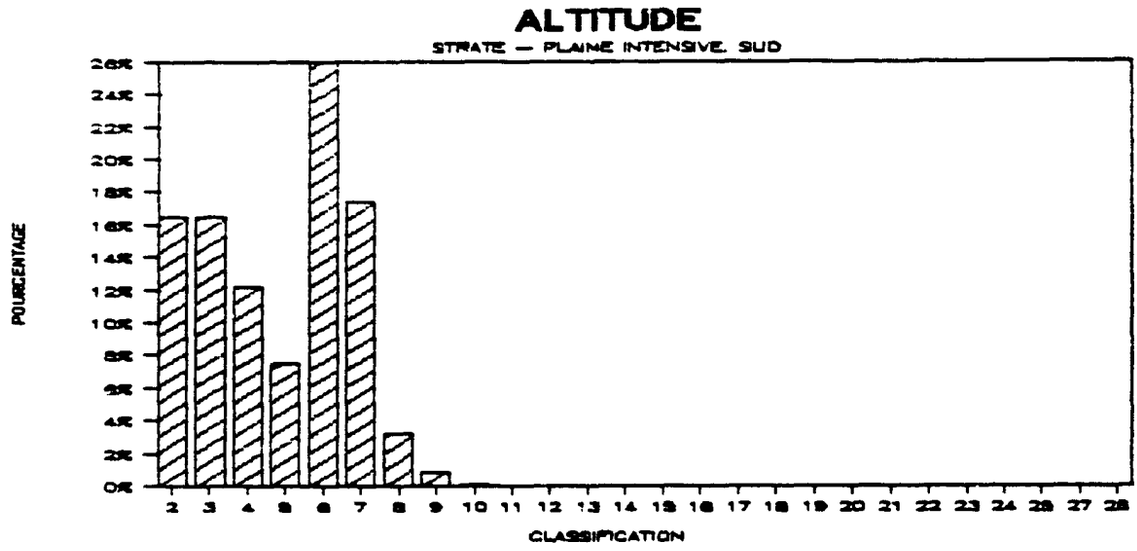
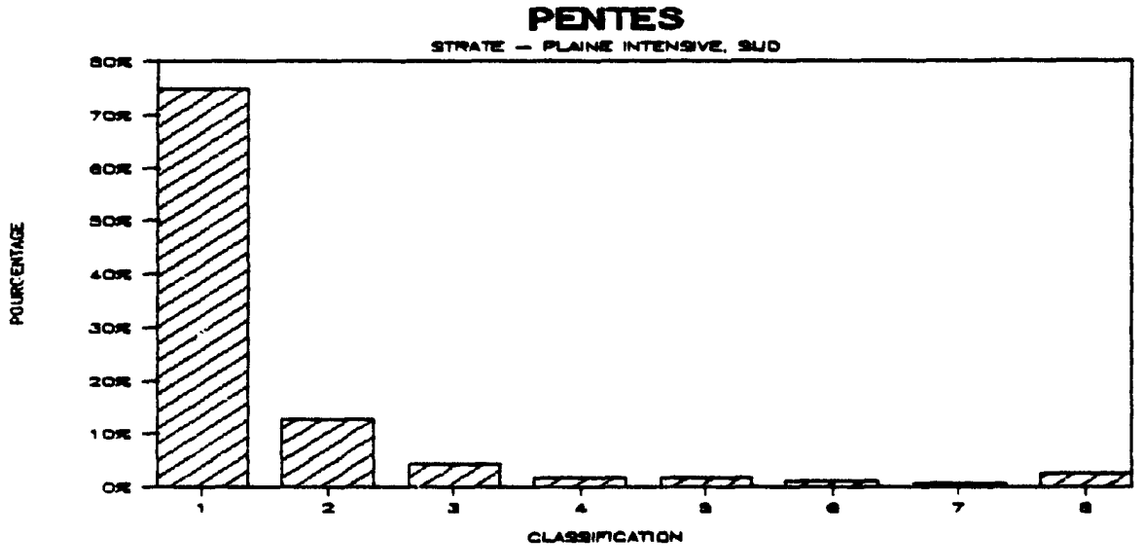

POTENTIALITE DES SOLS
STRATE — MONTAGNE EXTENSIVE, SUD
POURCENTAGE
CLASSIFICATION DE POTENTIALITE DES SOLS

Figure 8. (a)


ALTITUDE
STRATE — PLAINE INTENSIVE, SUD
POURCENTAGE
CLASSIFICATION

(b)


PENTES
STRATE — PLAINE INTENSIVE, SUD
POURCENTAGE
CLASSIFICATION

(c)

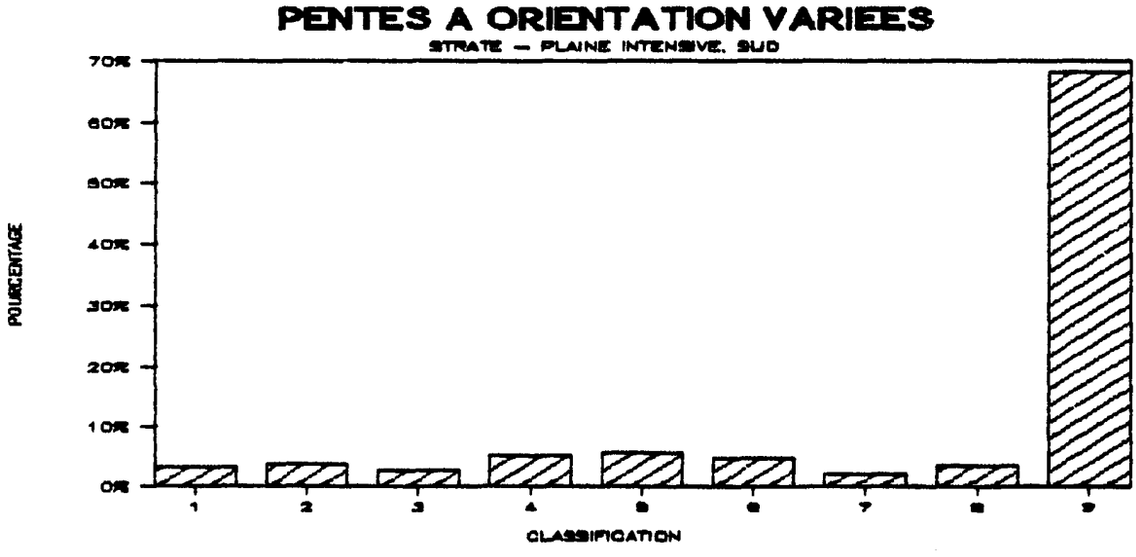
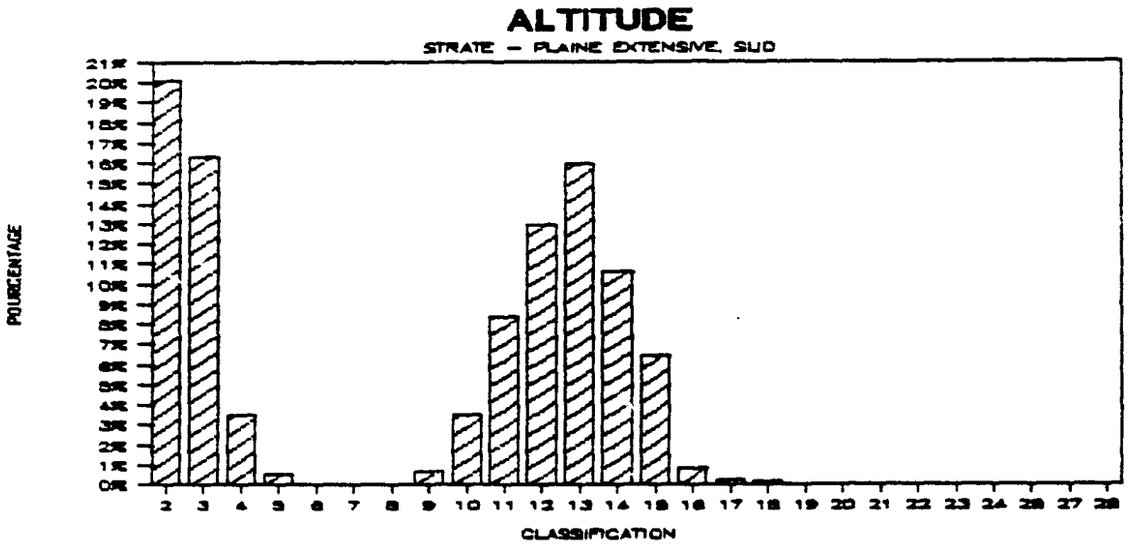
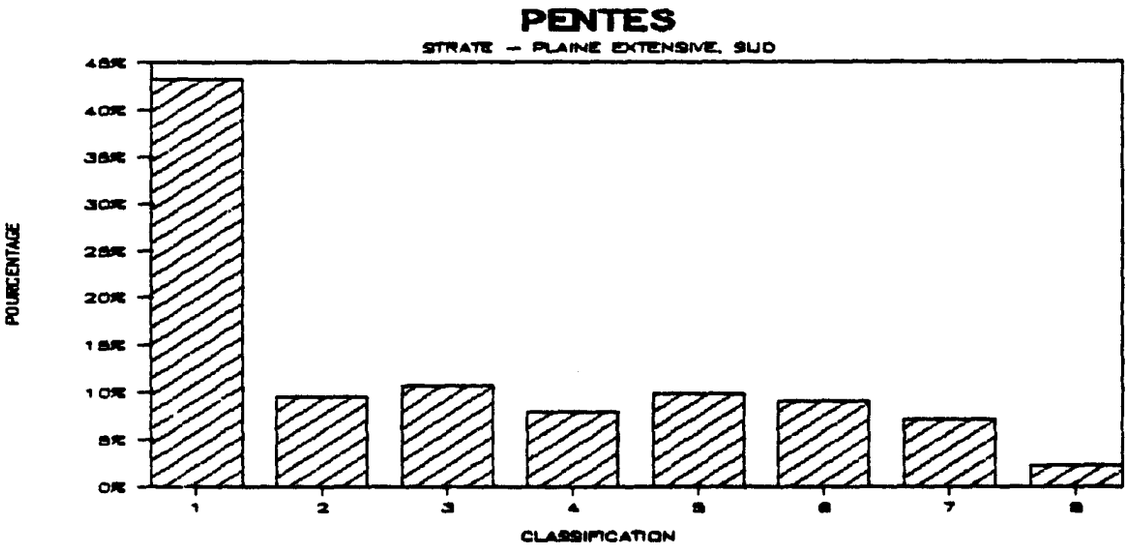

PENTES A ORIENTATION VARIEES
STRATE — PLAINE INTENSIVE, SUD
POURCENTAGE
CLASSIFICATION

Figure 9. (a)


ALTITUDE
STRATE – PLAINE EXTENSIVE, SUD
POURCENTAGE
CLASSIFICATION

(b)


PENTES
STRATE – PLAINE EXTENSIVE, SUD
POURCENTAGE
CLASSIFICATION

(c)

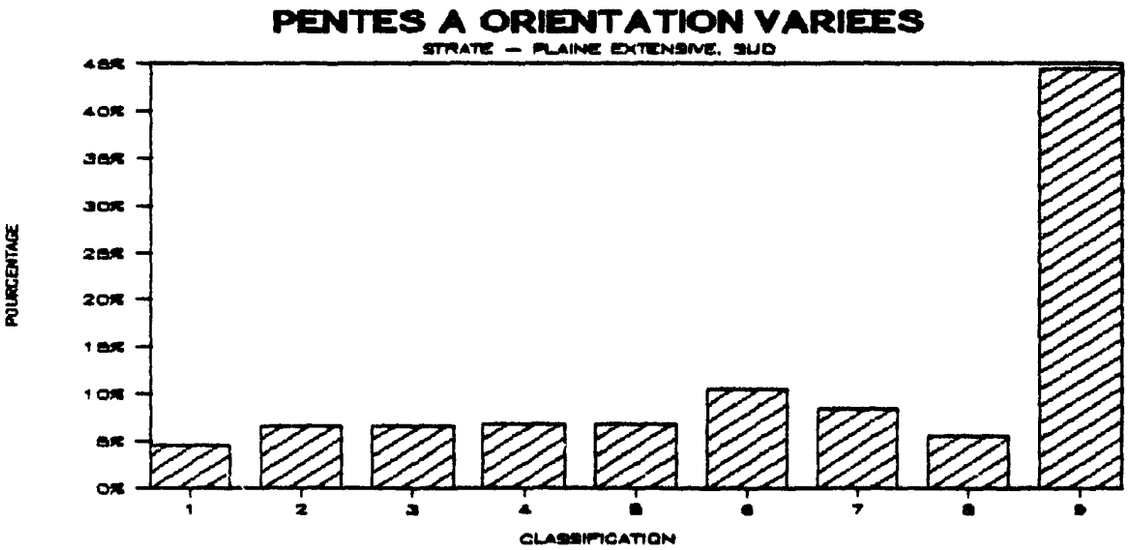
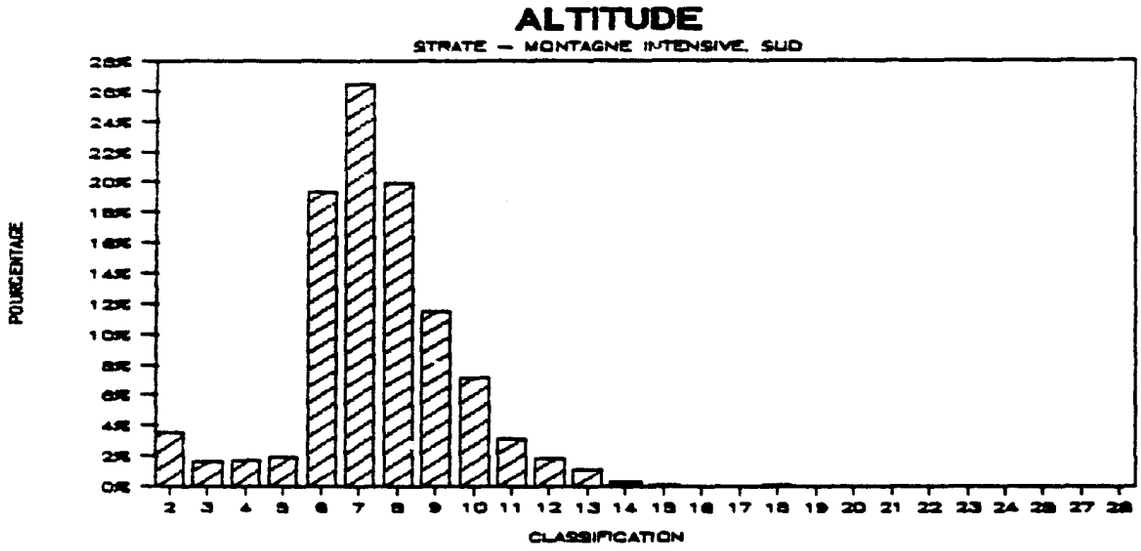
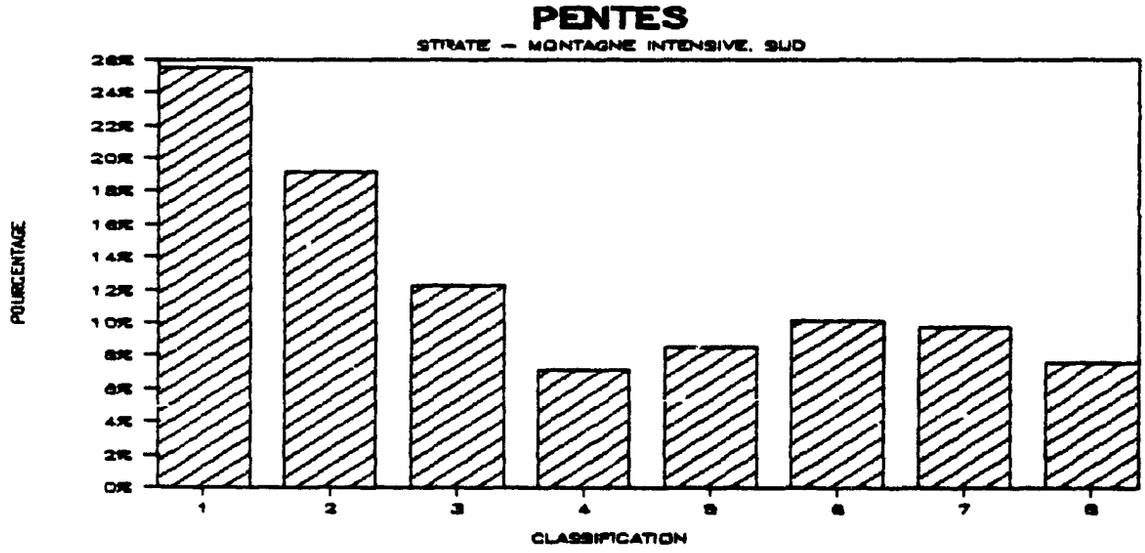

PENTES A ORIENTATION VARIEES
STRATE – PLAINE EXTENSIVE, SUD
POURCENTAGE
CLASSIFICATION

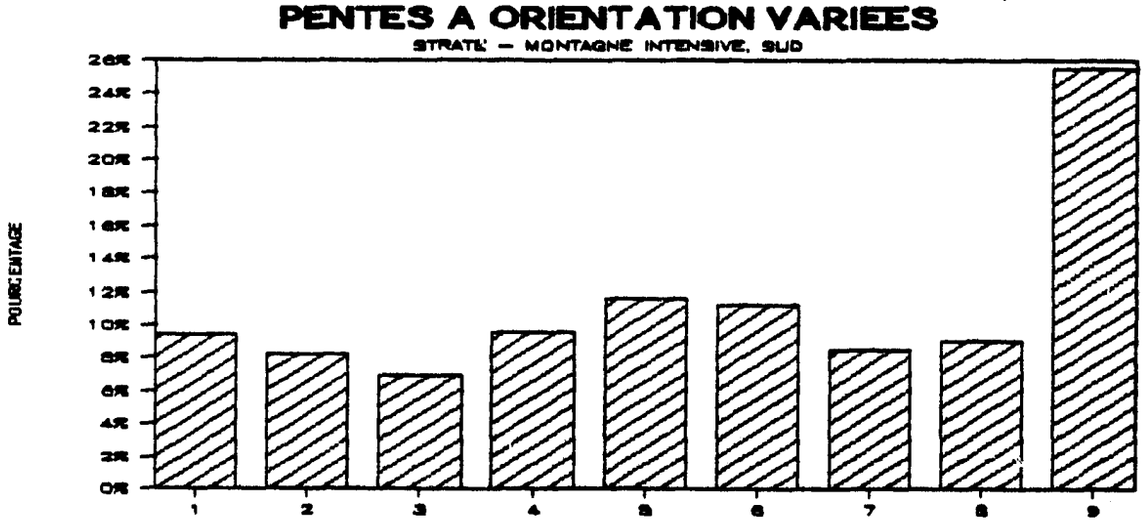
Figure 10. (a)



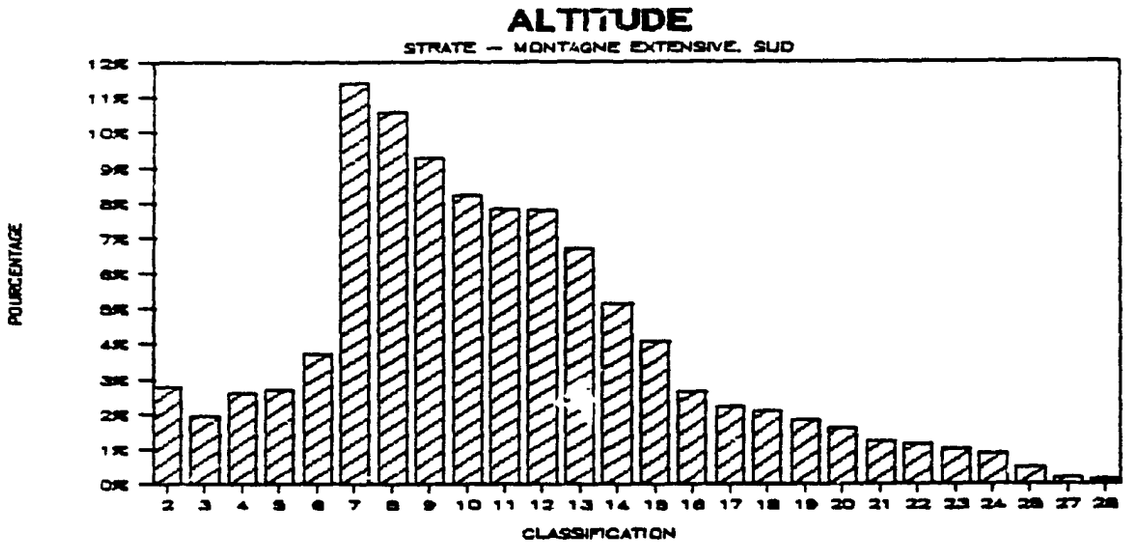
(b)



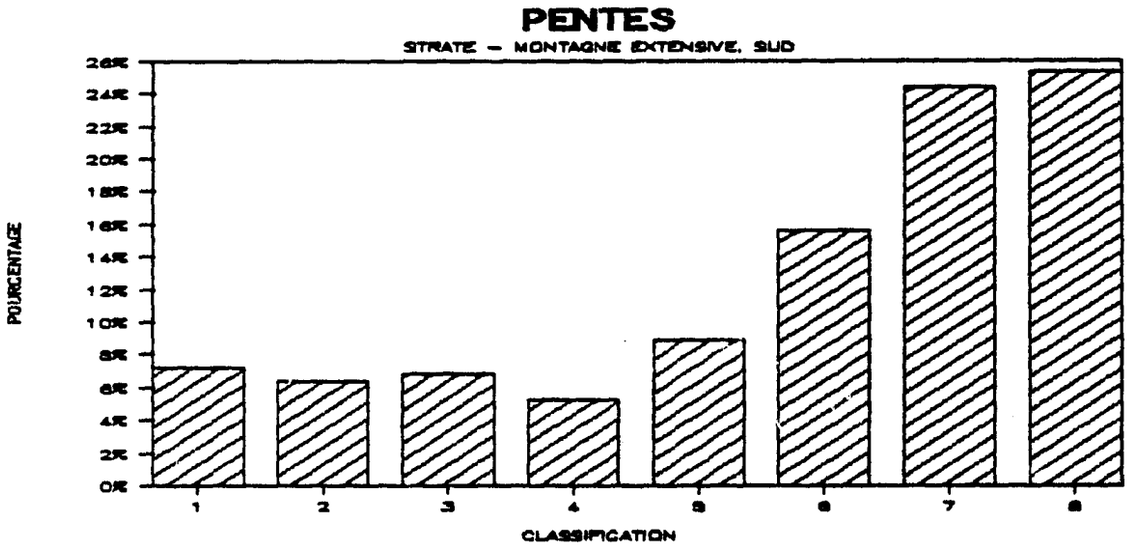
(c)



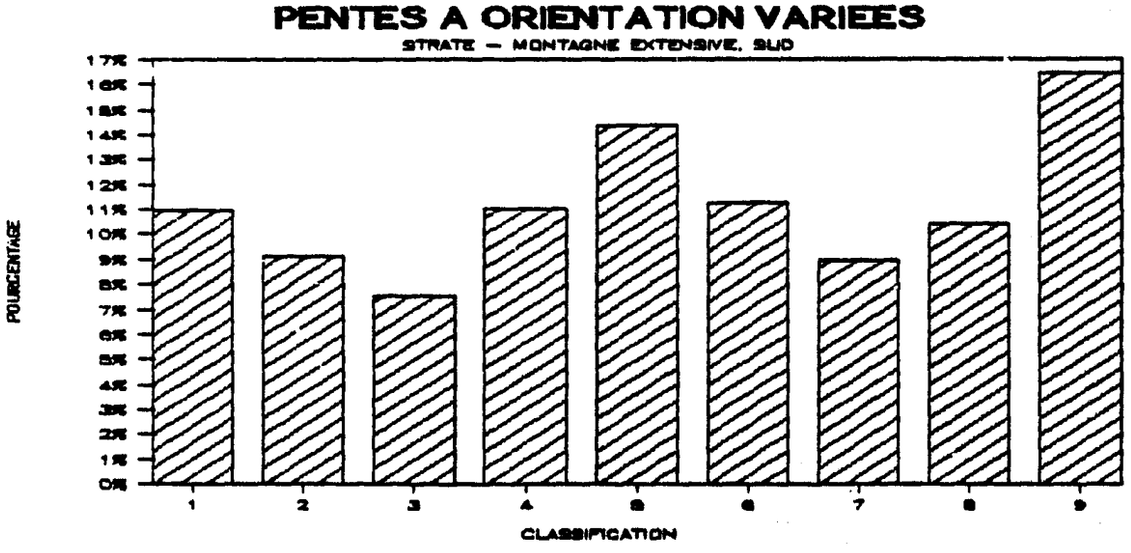
igure 11. (a)

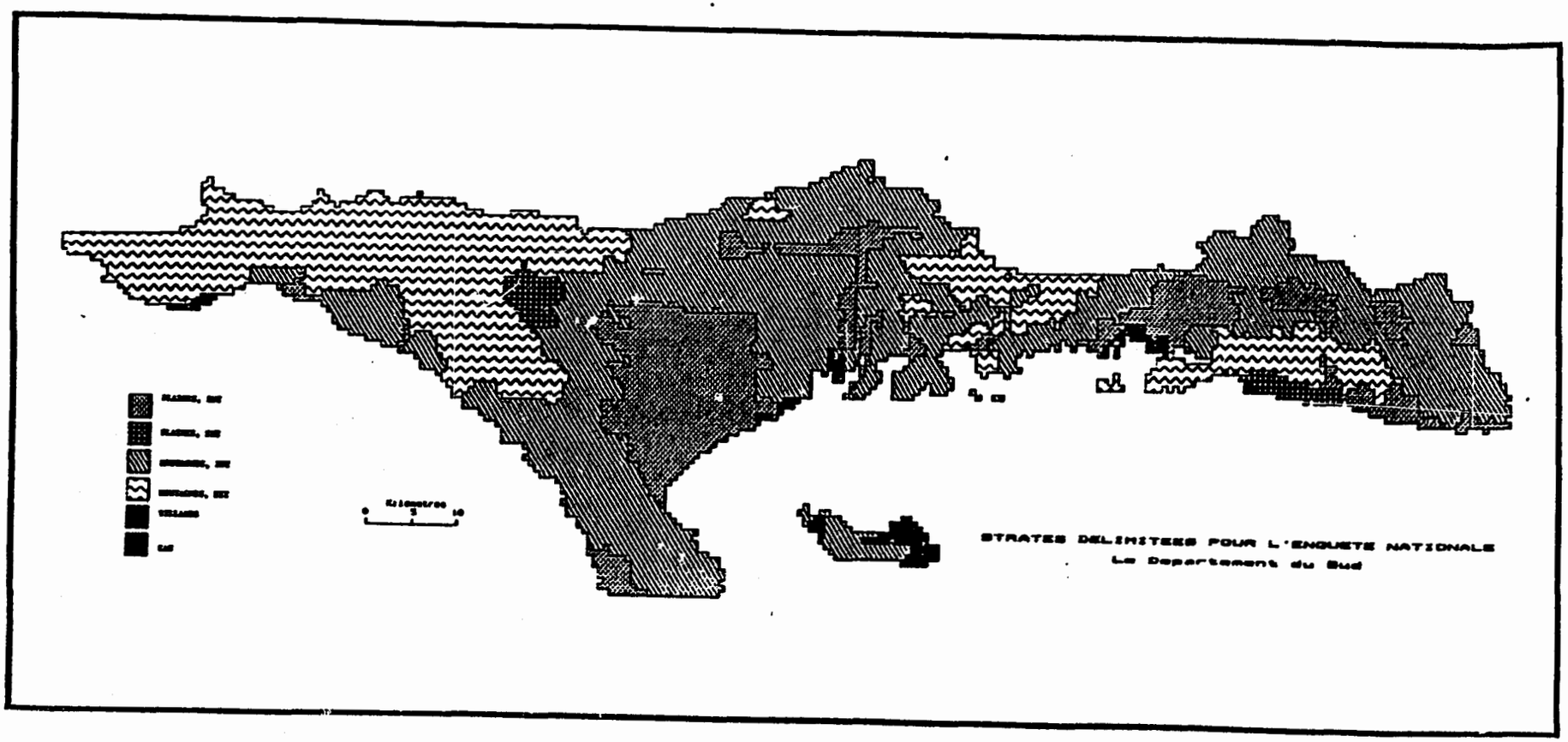

ALTITUDE
STRATE — MONTAGNE EXTENSIVE, SUD
POURCENTAGE
CLASSIFICATION

(b)

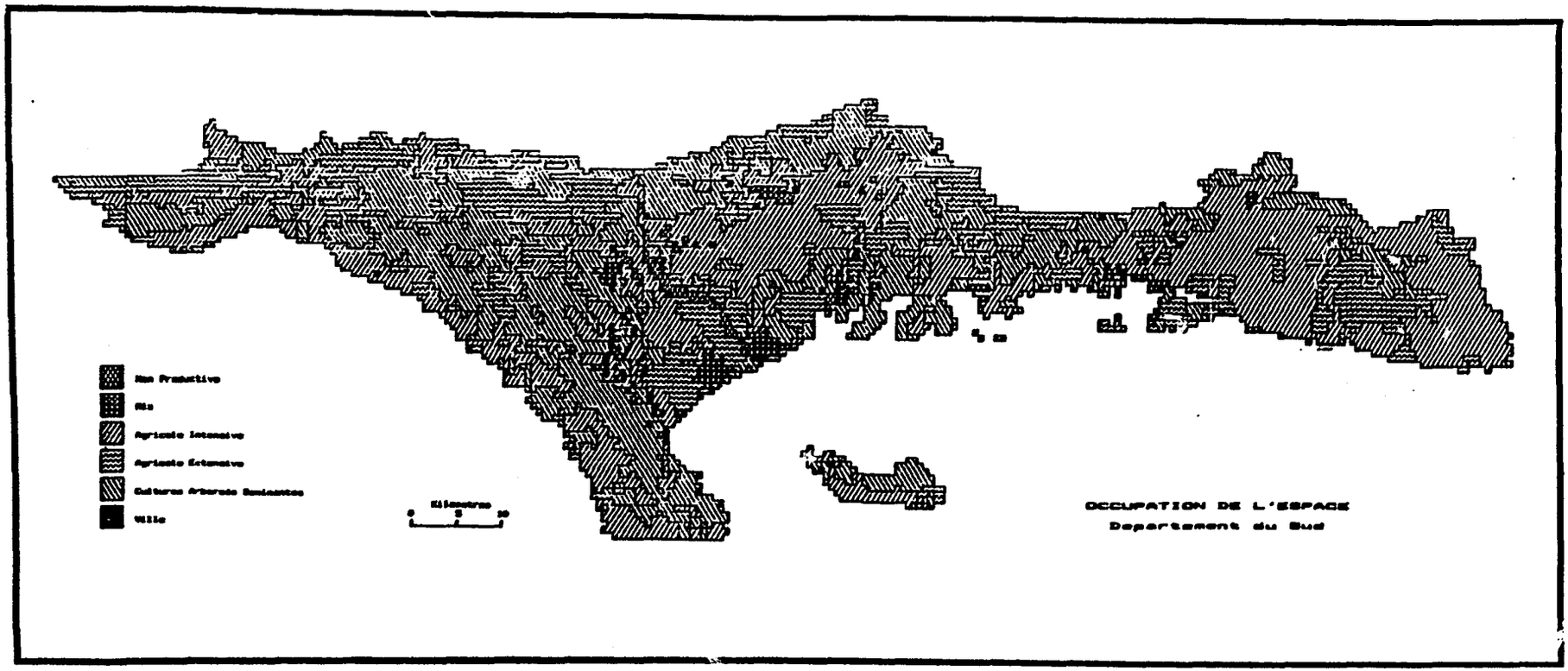

PENTES
STRATE — MONTAGNE EXTENSIVE, SUD
POURCENTAGE
CLASSIFICATION

(c)

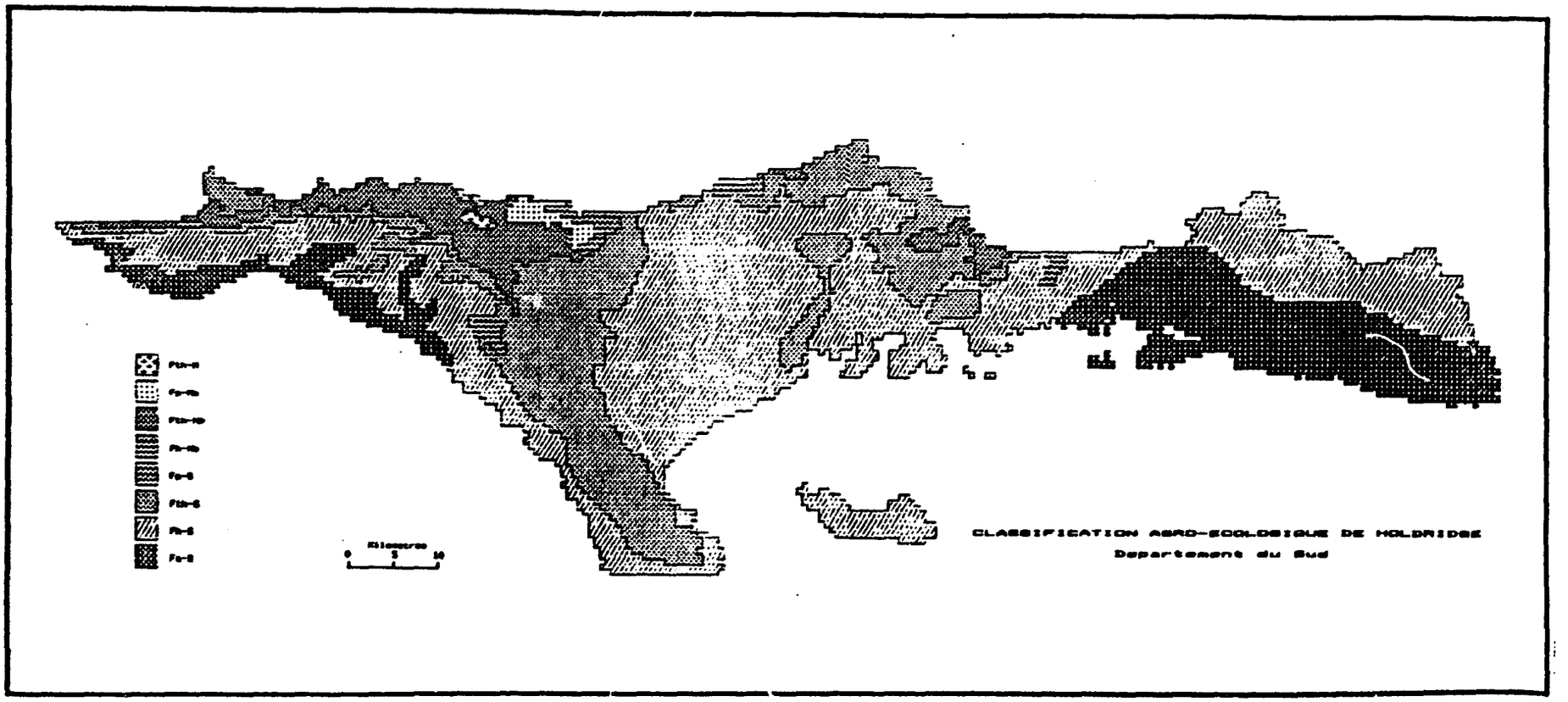

PENTES A ORIENTATION VARIEES
STRATE — MONTAGNE EXTENSIVE, SUD
POURCENTAGE
CLASSIFICATION


STRATES DELIMITEES POUR L'ENQUETE NATIONALE
Le Departement du Sud

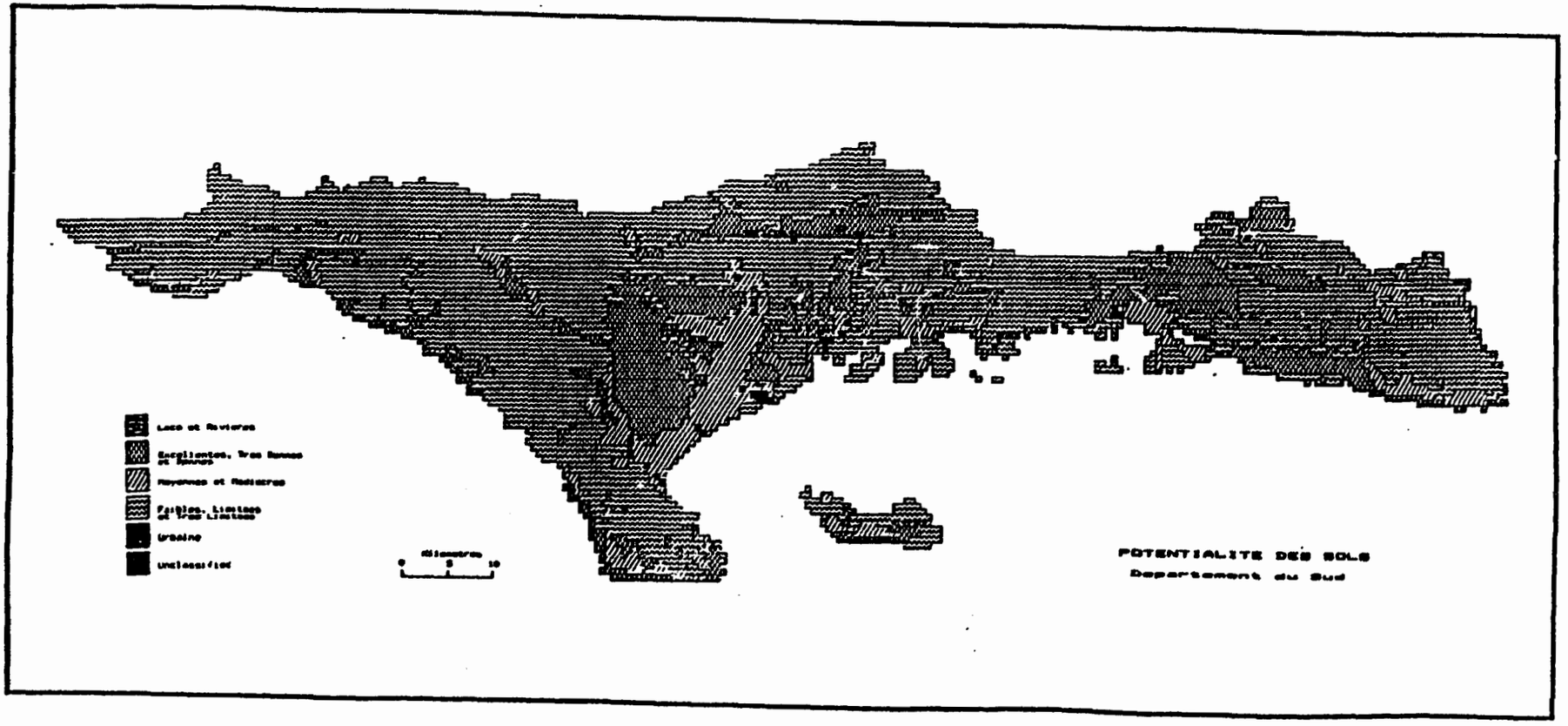
Carte 1.


Non Productive
Riz
Agricole Intensive
Agricole Extensive
Cultures Arborées Dominantes
Ville
Kilometres
0 5 10
OCCUPATION DE L'ESPACE
Departement du Sud

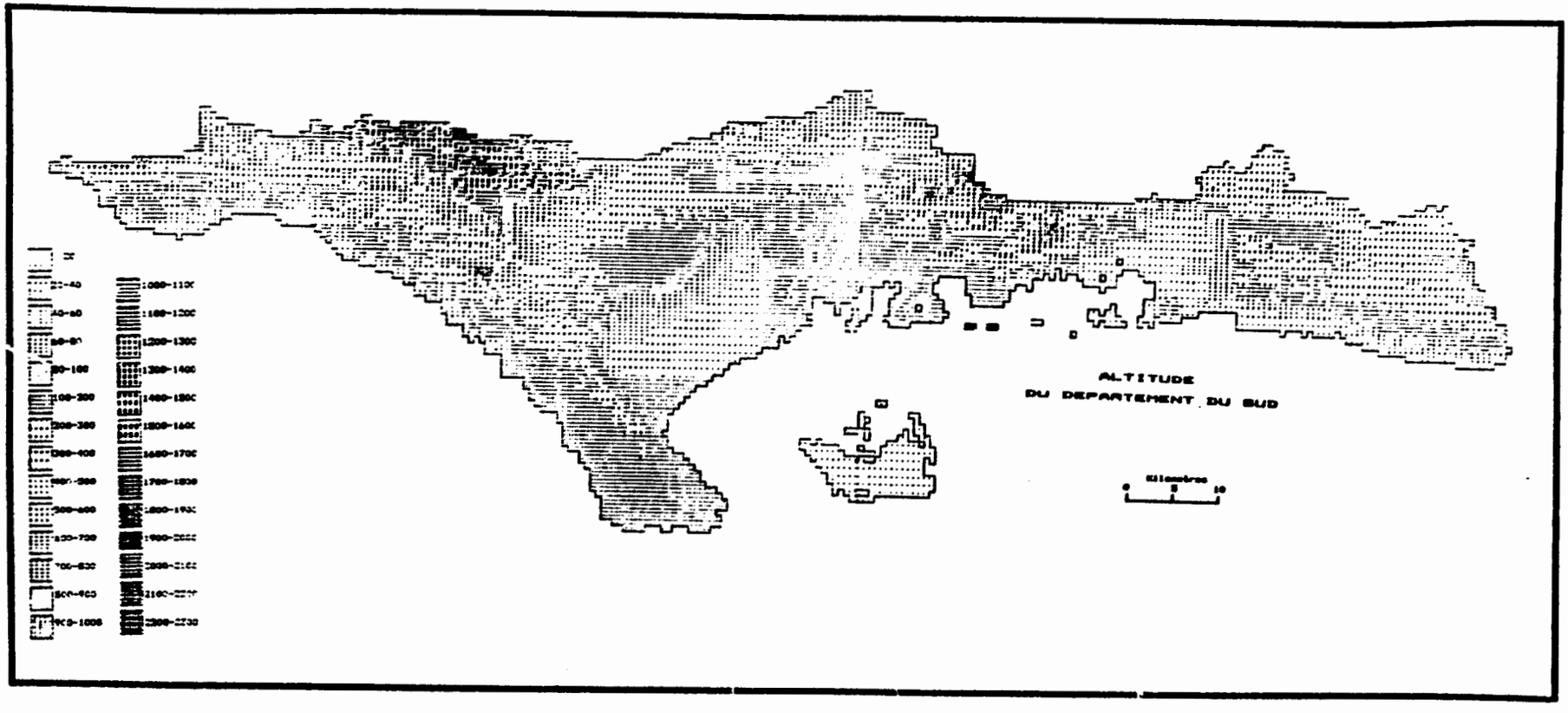
Carte 2.


CLASSIFICATION AGRO-ECOLOGIQUE DE HOLDRIDGE
Departement du Sud

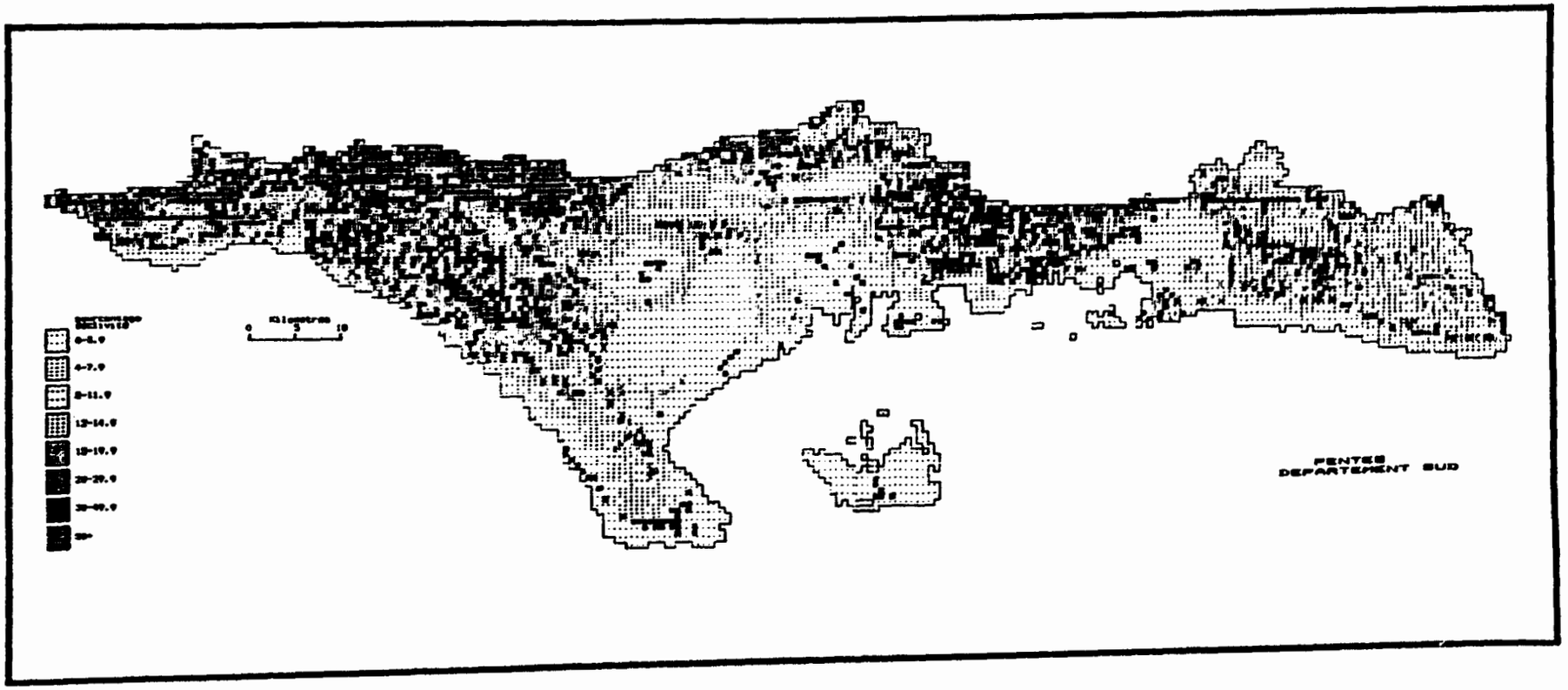
Carte 3.


Lacs et Rivieres
Urbaine
Unclassified
Kilometres
0 5 10
POTENTIALITE DES SOLS
Departements du Sud

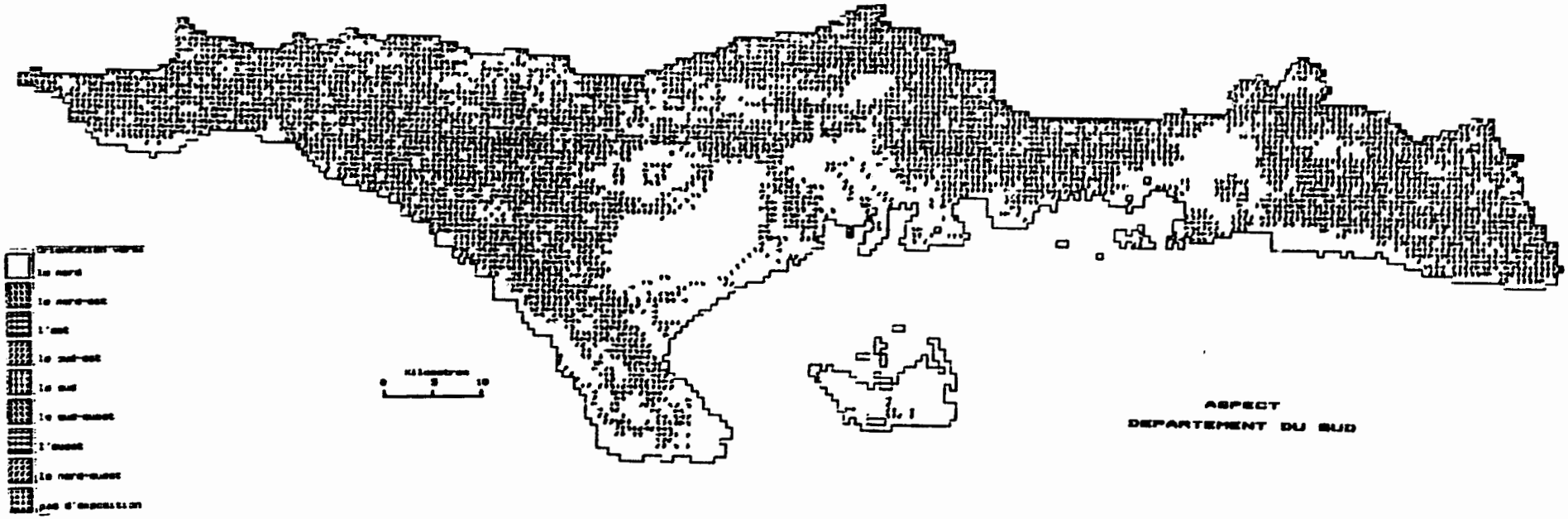
Carte 4.



Carte 5.



Carte 6.


le nord
le nord-est
l'est
le sud-est
le sud
le sud-ouest
l'ouest
le nord-ouest
pas d'exposition
Kilomètres
0
5
10
ASPECT
DEPARTEMENT DU SUD

Carte 7.