Social-economical Database Implementation into GIS to Analysis Land Suitability for Citrus Fruit Production

A Case Study in the Thua Thien Hue Province, central Vietnam

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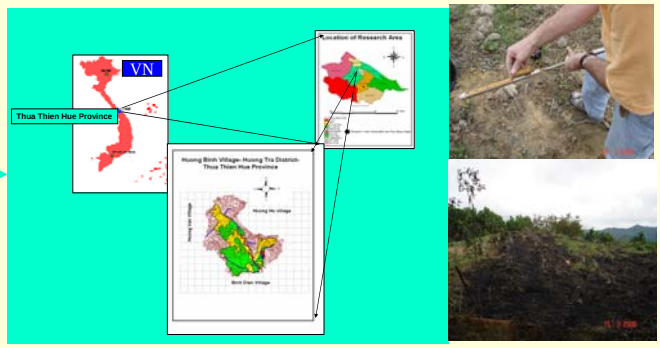
Introduction

Land suitability analysis and land use planning is being considered as a very complex question since it is usually solved by multi-criteria and interdisciplinary approaches. In general, land suitability analysis indicates the influences of physical in relation with social-economic, infrastructure, environmental issues for agricultural crops. In which social-economic and infrastructure database are used and described for maps manipulation in land evaluation and land use planning. This study aim at integrating the social-economic and infrastructure database into GIS together physical data in order to analysis the land suitability for promising citrus fruit crops in Huong Binh commune, Thua Thien Hue Province, Central Vietnam. The result of land evaluation can be used for planning based on physical conditions. The second way of evaluation is based on the socio-economic and infrastructure conditions to give more precisely results that related to the socio-economic conditions.

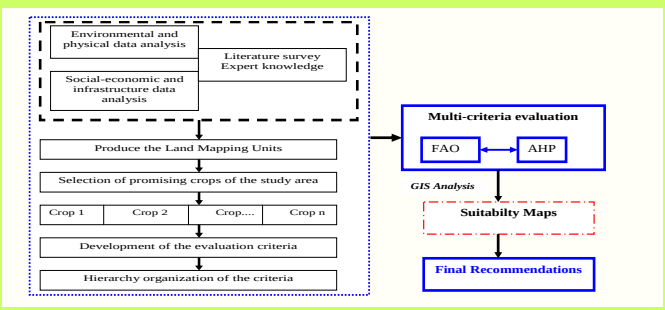
Study location description and materials used

-***The study area selected:*** was a hilly commune Huong Binh of Thua Thien Hue province, the topography is quite complex including various shapes, the climate conditions distingue two seasons, dry season (month 3-8), rain season (month . Mean annual temperature is 24C-250C; total rainfall about 2,555mm, however most rainfall concentrated in the rainy season, while there are rarely rain in May to July which harmful for agricultural crops.
Total natural land of the commune of 6.337 ha, there are 4 major soil groups with 16 soil units and 23 sub-soil units (Acrisols (AC), Cambisols (CM), Leptosols (LP), and Ferrasols (FR)). Soils were divided into three types of the texture components (light soils, heavy soils and clay soils), topsoil depth about 50-more 100 cm, low soil fertility and low pH (<5.5).
- *Materials used:* Spatial data sources were collected and inherited including soil map, topography map, current land use maps (2005), land use planning maps (2000-2010). All existing GIS databases were stored in Mapinfo software. Attribute data sources included location, climates, the last census of physical, social-economic, infrastructures, and fruit information relating with spatial data above and crop systems. Softwares uesd include MS Excel 2003, Mapinfo 7.5 and ArcView 3.2 software, Expert Choice 11.0



Methodology and Main Steps for Suitability Analysis

- *General methods*: Inheritance method of available information and database sources, secondary data inventory and gathering method, interviewing, discussion and seminar method, field observation and mapping editing, thematic map overlaying method and statistics data process.
-Framework of land suitability analysis for selected citrus fruit crops:

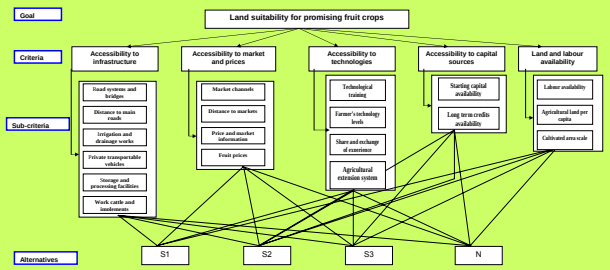


Main Steps

(1) Selection of promising citrus fruit crops: Based on the six targets above and objectives, for this study area, the different citrus fruit crops for evaluation that are considered including Orange (Citrus Nobilis); Sweet Orange (Citrus reticulata. B); Lemon (Citrus Aurantifolira. C. & Panz).
(2) Criteria selection for physical land suitability: soil type, soil texture, soil effective depth, soil slope degree, soil reaction (pH), soil fertility.
Table 1: Factor rating of land quality for hilly land citrus fruits *(Citrus rutaceae)*

Diagnostic factor	Unit	Factor rating			
		S1	S2	S3	N
Mean temperature in growing period	^{0}C	25-30	30-33; 25-18	33-35; 18-13	>35; <13
Average annual rainfall (R)	mm	1500-2000	2000-2500 1200-1500	2500-3000 1100-1200	>3000 <1100
Organic Carbon (OC)	%	>2.5	1.0-2.5	<1.0	
Total Nitrogen (N)	%	>0.2	0.1-0.2	<0.1	
Available Phosphorus (P_2O)	ppm	>15	6-15	<6	
Available Potassium (K_2O)	mg	>15	10-15	<10	
Soil reaction (pH)	-	5.5-6.5	6.5-7.5; 5.0-5.5	7.5-8.5; 4.0-5.0	>8.4; <4.0
Soil depth (D)	cm	>100	70-100	50-70	<50
Slope gradient (SL)	degree	0-3^0	3-8^0	8-15^0	>15^0

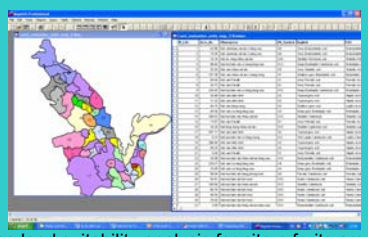
(3)Criteria selection for social-economic and infrastructure: there are 5 main criteria and 19 sub-criteria (see figure)

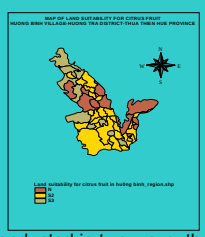


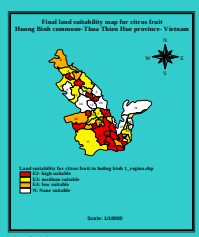
(4) Matching the final suitability classification: Once the weight value assigned for each class of each map, all of maps of factors for each land use type will be multiplied together. In order to classify for the suitability classes, the GIS reclassification method will be applied. Si = ∑Xi x Wi (Wi is Weighting of the each criterion, Xi is fact value of each criterion.

Results and Discussion

The Land Mapping Units and attribute information*:* The LMU was based on combinations of soil units, soil slope, soil depth, soil texture layers. There are 36 LMUs which was identified in the Huong Binh commune. Map and attribute information were recorded in Mapinfo and ArcView softwares.







The land suitability analysis for citrus fruits are conducted in two ways, there are:
(1) physical land assessment and
(2) social-economic, infrastructure assessment

Physical land suitability for citrus fruit in the study area: Physical land suitability analysis involves the matching of the land characteristics of a land mapping unit (LMU) with the requirements of citrus fruit crops. This partial suitability for separate land characteristics must be combined to come to the overall suitability of the LMU for the citrus fruit crops. The results of the physical land suitability for citrus fruit crops are showed in the table 2 and the Map above

Table 2: Results of physical land suitability

Suitability level	Area (ha)	(%)
S1	0.00	0.00
S2	850.55	26.09
S3	1256.14	38.53
N	1144.87	35.38
Total area	3260.56	100.00

Table 3: Results of social-economic, infrastructure suitability

LMU	Area (ha)	S Level	Suitbility index
-	0.00	S1	8-9
1,8,15, 19, 22, 24,28,30,31,32,33	731.33	S2	6-8
4,7,11,13,17,20,21,26,29,35,36	1124.88	S3	5.5-6
2,3,5,6,12,14,16,18,25,27,34, 9,10,23	1404.37	N	-
Sub-total	3260.58		
Other land	3076.42		
Total area	6377.00		

Social-economic and infrastructure land suitability for citrus fruit crops in the study area: The methodology for the assessment of socioeconomic and infrastructure is different as compared to physical land evaluation, in which the factors of social-economic and infrastructure accessibility are used as the major constraints effected to the classification of citrus fruit crops. Results of suitability classification of the citrus fruit crops in marginally to high physical suitable area that based on the socioeconomic and infrastructure conditions were showed in Table 3 and the Map above.

Conclusions

- Three promising citrus fruit crops were selected and classified for suitability of 36 land mapping units in the Huong Binh commune. There are 855.40 ha moderately suitable (S2), 1250,55 ha marginally suitable (S3) and 1144.60 ha none suitable (N). Low soil fertility, soil types, scarce water resources, slopping land are main constraint physical factors for decision of area extension.
- Main characteristics of social-economics and infrastructures conditions for suitability analysis for citrus fruit production that classified as marginally to moderately suitable, in which rural road systems, product prices, technologies and land use planning are main constraint factors for decision of area extension.
- Integrating of the social-economic, infrastructure database into GIS together with the physical data for land suitability analysis is a very powerful and robust tool for land suitability analysis and decision making process and land use planning.

Acknowledgments
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