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Sustainability Standards for internationally traded Biomass

Sustainable Biomass Production in China

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Contents

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China

- still a developing country
- third-largest bioethanol producer in the world
- In 2008:
  - biodiesel production : 360,000 tons,
  - bioethanol production : 1.62 million tons (*Frost & Sullivan, 2009)*
- Government (NDRC-NEA) targets for 2010
  - bioethanol production; 2 to 2.6 million tons *(Shi Jingli, ERI-NDRC, 2007)*
  - biodiesel production : 0.2 to 0.7 million tons *(Gao Hu, ERI-NDRC, 2007)*

Source: ECO-Asia CDCP; Country level ministries and bureaus of statistics

Table 1. Forecasts of Annual Gasoline and Diesel Consumption in the Focus Countries (Billions of liters)

COUNTRY	2008			2030								
	Actual			Low Growth Scenario			Medium Growth Scenario			High Growth Scenario		
	Petrol	Diesel	Total	Petrol	Diesel	Total	Petrol	Diesel	Total	Petrol	Diesel	Total
China	79.3	157.9	237.2	87.8	174.8	262.6	152.0	302.6	454.5	285.8	569.0	854.8

China

- Except COFCO (China National Cereals, Oils and Foodstuff Corp.) factory based on cassava in Nanning, Guanxi, and the Henan Tianguan factory (partially corn straw), the ethanol production facilities, among them the largest bioethanol refinery in Jilin with a capacity to process 2.3 million liters per day (Modl 2004) were all based on corn and one of them partially on wheat.
- In 2007, this production line and with it the E10 Ethanol Mixed Gasoline Program came to an abrupt halt: State Council excluded the use of grains and green grain crops for biofuel and other forms of bioenergy.

→ →Switch to “non-food” celluloses for bioethanol production, and waste food grade oil and jathropha for biodiesel production.

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Team

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Li Zifu, Heinz-Peter Mang, Mario Lucas et.al.

Jiuzhaigou National Park, Sichuan
Leader WP2 : Spatial Identification of Potential Areas for Biomass Production
Leader WP5: Positive List of Habitats for Biomass Production
Chen Haoran, Andrew Scanlon

China Meteorological Administration (CMA), National Climate Centre (NCC)
Leader of WP 1: Brief Overview on the Availability of Spatial Data
Jiang Tong, Marco Gemmer et.al.

Chinese Academy of Agricultural Sciences
Leader WP3: Cultivation Systems and Calculation of Biomass Potentials
Wilko Schweers, Qin Zhihao, Li Wenmei et. al.

All Consortium Partners are supported by German development cooperation // Centre for international Migration and Development http://www.cimonline.de

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WP 1: Overview on the Availability of Spatial Data (International & Chinese datasets):

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Topic	Chinese Data sets	International Data sets
Degraded Land	7	9
Abandoned Land	3	2
Unused Land	5	2
Land-use Data	3	6
Suitability Maps for Cropping	5	4
Soil Quality	6	17
Biodiversity Relevant Areas	10	14
Forests	3	21
Wetlands, Water and Hydrology	7	18
Land Classification System	2	10
Social Aspects	2	3
Differentiation of Spatial Info	2	1
Remote Sensing Links	0	4
Other Links	0	5

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Available Chinese Datasets

China sources of information covering China

Database /Product	Reference	Data Provider	Definition	Data Quality	Availability	Product Format	Resolution	Frequency of Updating	Costs

Available International Datasets

Internationally available information preferably covering China (besides other countries)

Database/ Product	Reference	Data Provider	Definition	Data Quality	***Geographi-cal Area Covered***	Availability	Product Format	Resolu-tion	Frequency of Updating	Costs

WP 1: Overview on the Availability of Spatial Data (International & Chinese datasets):

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Data prioritized according to:

- Rapid availability
- Geographical area covered
- Costs
- Draft decision tree

Very often GIS data are not freely available and access is restricted

Metadata and data standards for Chinese data are often different from international datasets

Chinese data sets are often based on international data sets (vis-versa-loop!?)

The use of Arc GIS products is recommended to better catalogue future developments in the sector

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Work Package 2: Top Down Identification of Sites and related GIS data samples.

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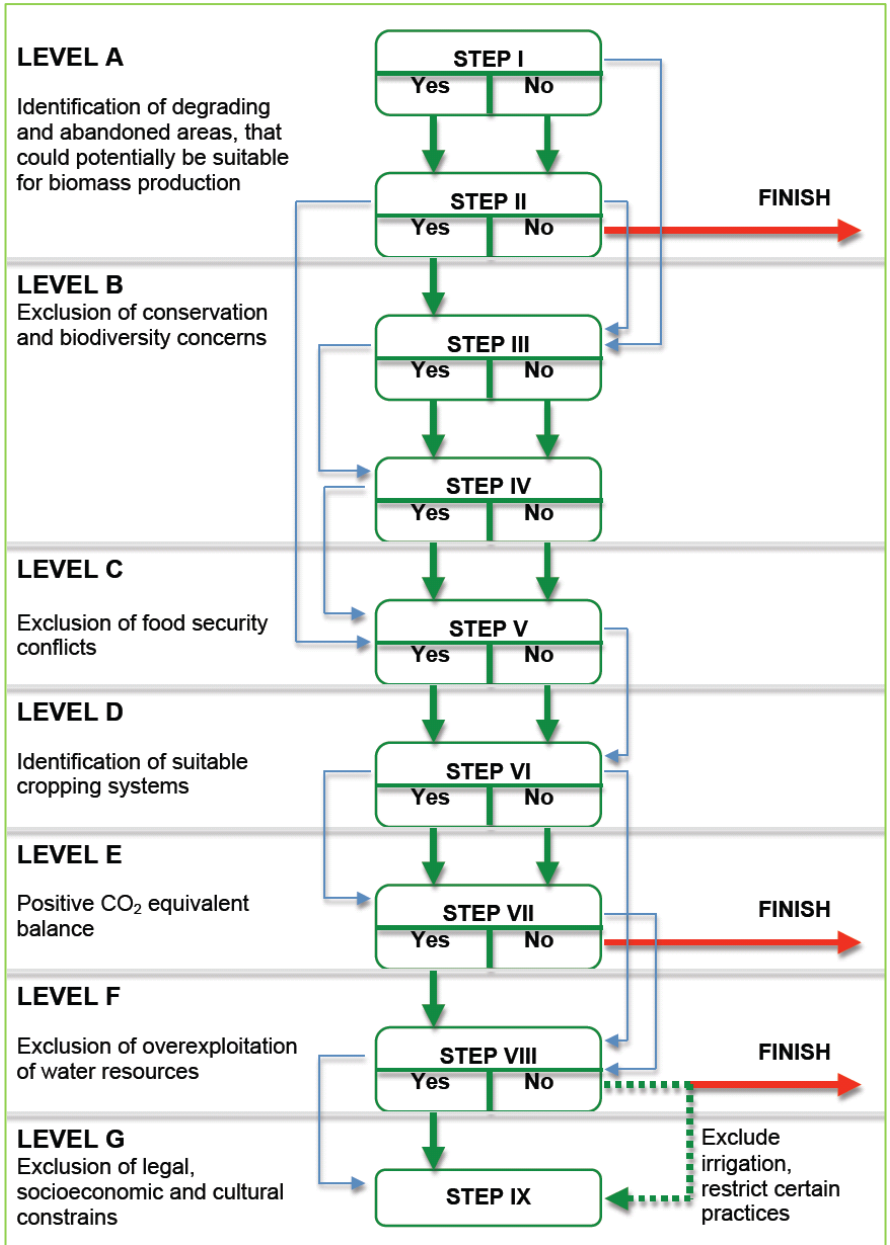

Part 1: Development of Decision Tree

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WP2 – part 2: Provision of GIS Data for Mapping Degraded, abandoned and Biodiversity Relevant Land on National and Sub-national scale

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Problems:

Chinese data is often badly collected, some mapping databases without meta data & international GIS Standards,

GIS data in China is recycled and reused, digitised and re-digitised, re-projected over the past 20 years now

Shapefiles are incorrectly projected and there are legal issues with county level (not national) Data Sets Access and End-User rights

Most of the data available in China is in chinese language with (if any) Chinese Metadata.

Ground Control is very important because decisons only based on Chinese data is often not „confiable“

without ground control they can‘t be tested for error; verification on ground requires a lot of expensive field work.

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Combined areas of potentially suitable degraded and abandonded land in China

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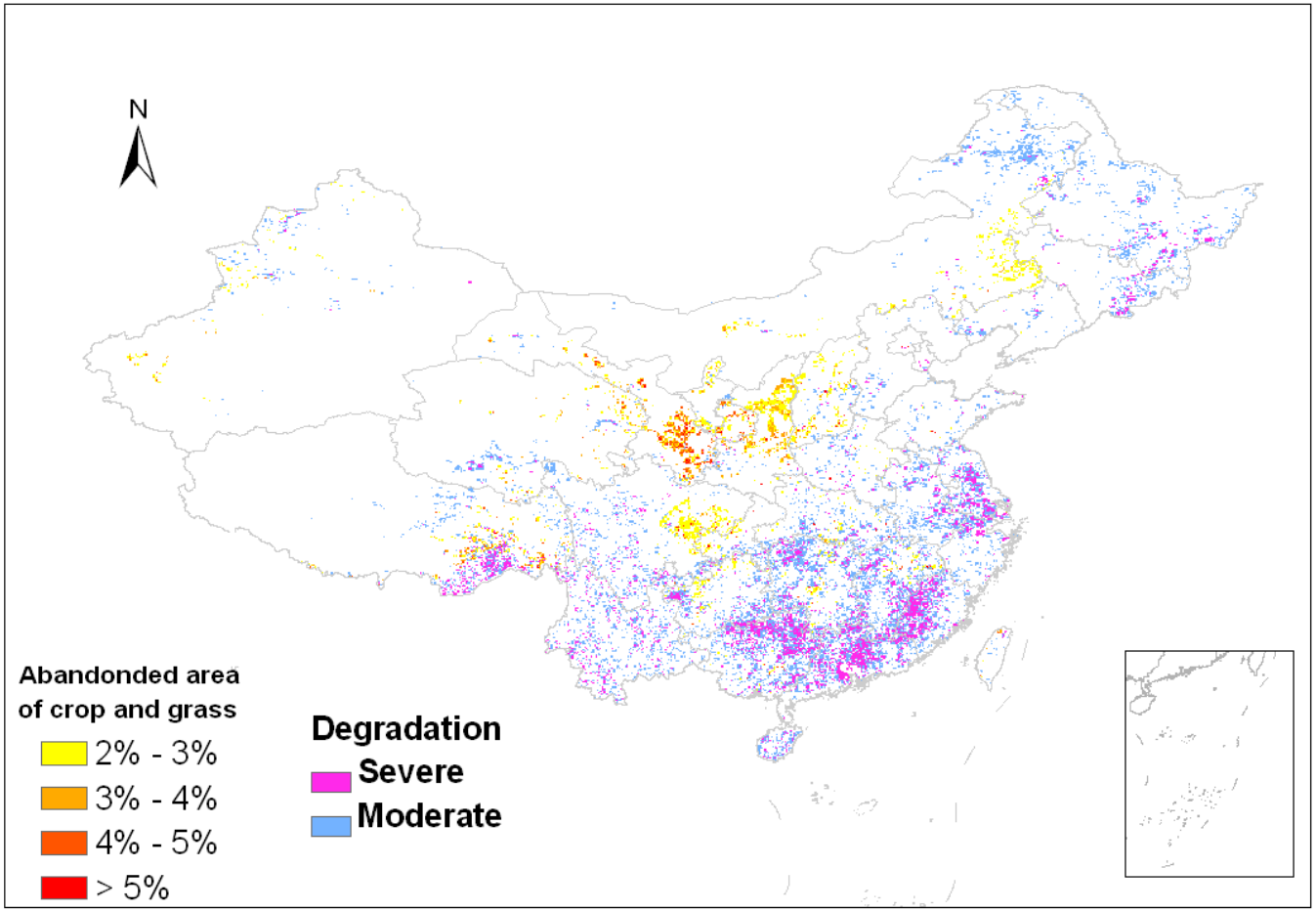

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WP3: Cultivation Systems and Calculation of Biomass Potentials

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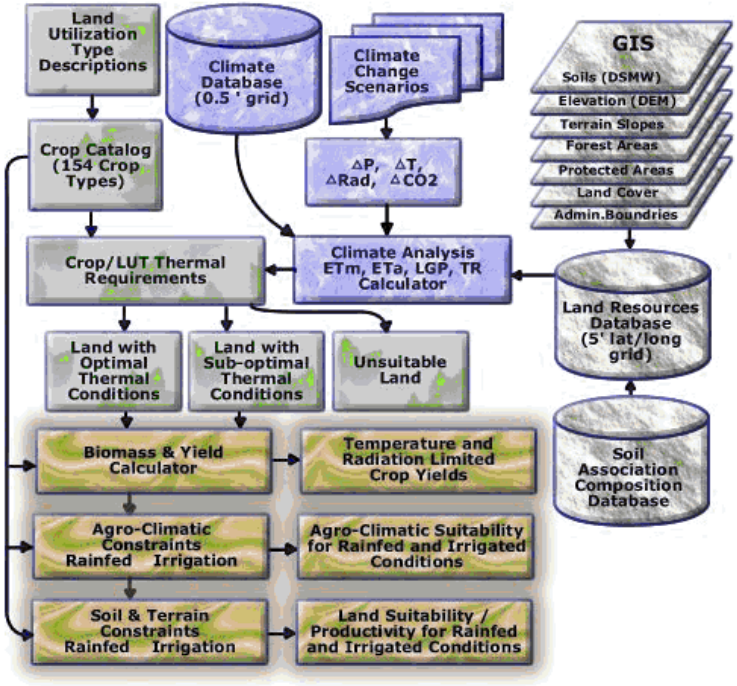
Information sources on crop agro-ecology and land suitability



AEZ (Agro-ecological Zoning) decision support system

(Source: IIASA, Laxemburg http://www.iiasa.ac.at/Research/LUC/GAEZ/index.htm?sb%20=%206)

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Potential energy crops analysed

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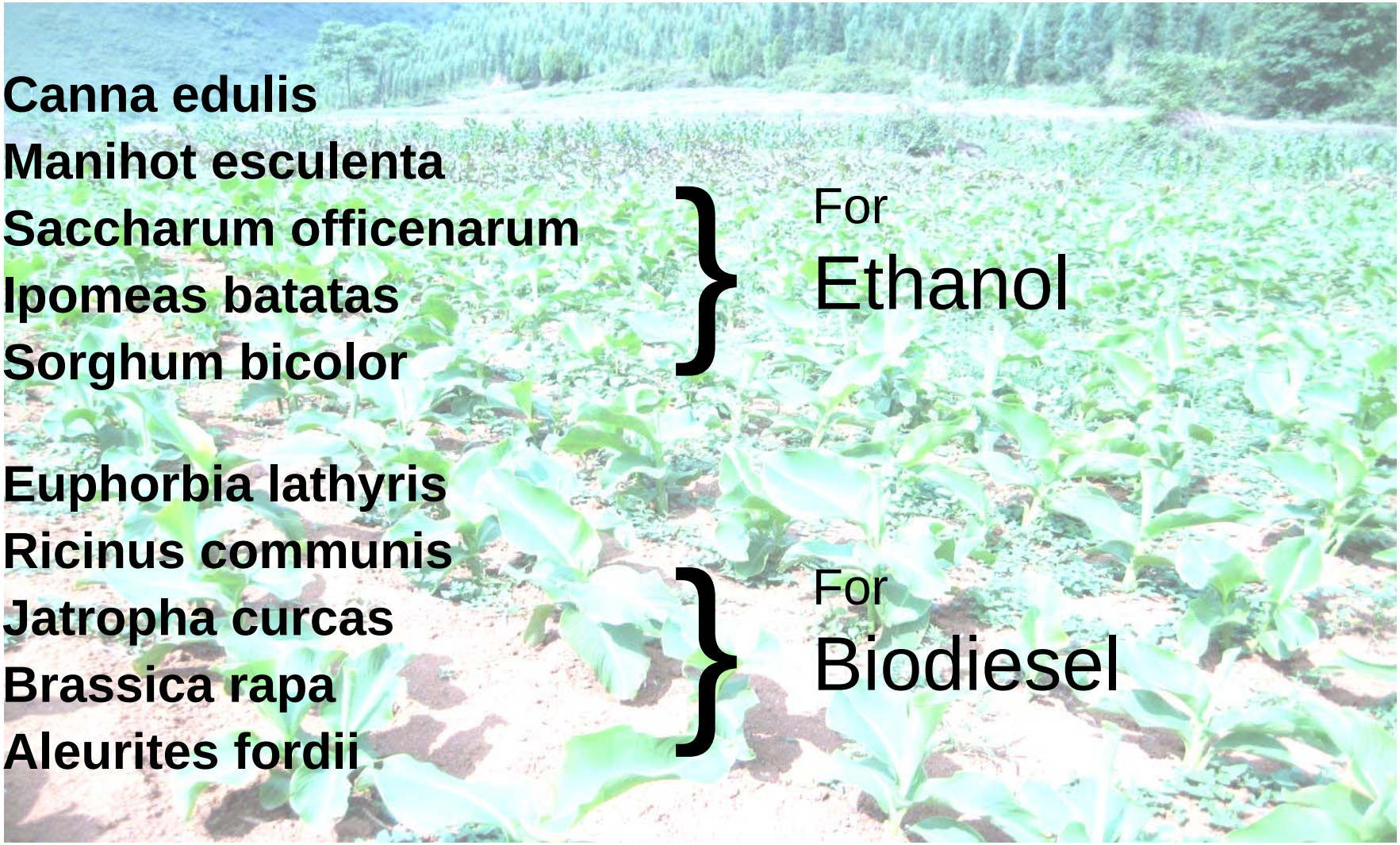

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Sustainable cropping systems

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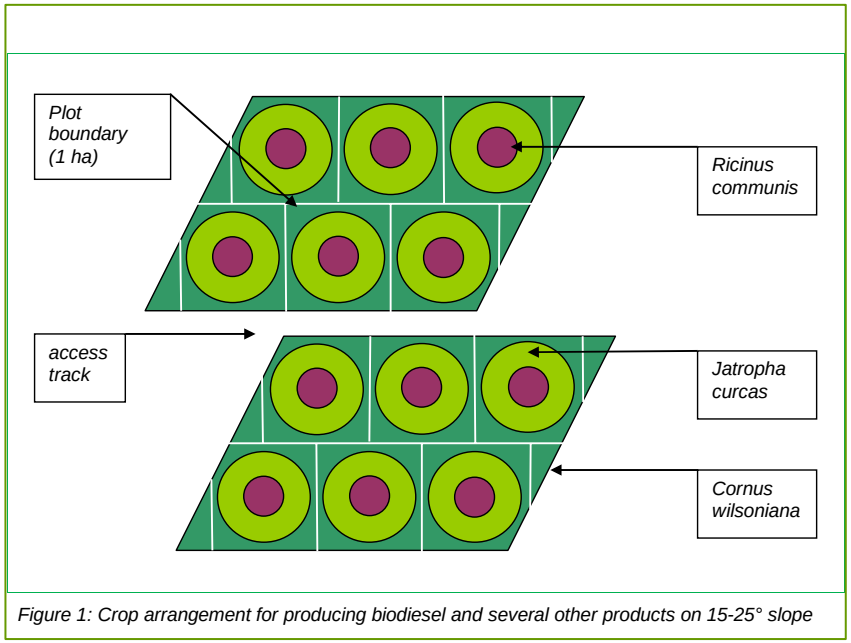

Figure 1: Crop arrangement for producing biodiesel and several other products on 15-25° slope

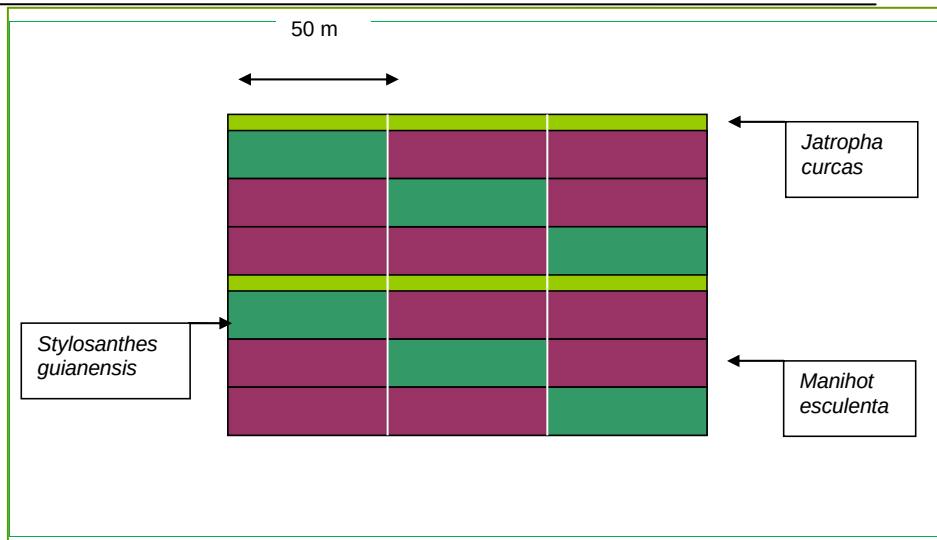

Figure 1: Cassava, and a legume (e.g stylosantes) in rotation on 5-15° slope with hedges

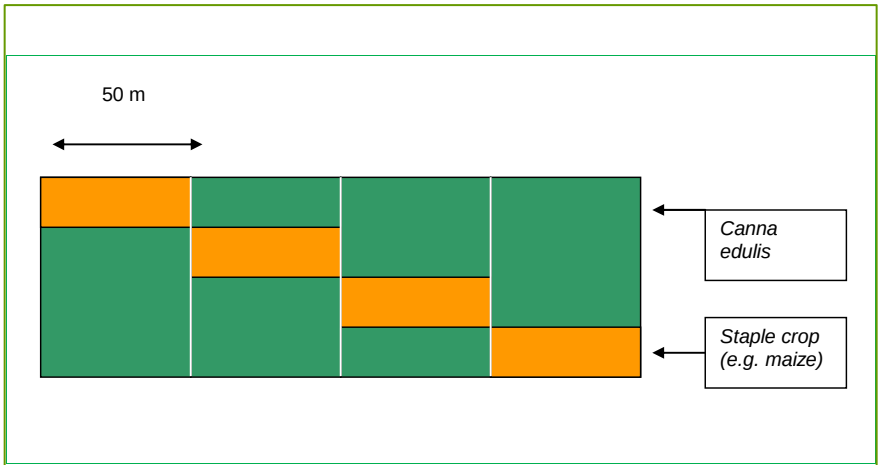

Figure 1: Canna edulis, and food crop (e.g maize) on rotation on land < 5° slope

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Potential of selected bioenergy crops

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	Crop	Suitability for degraded land?	Potential area (ha)		Yield/ha (tons)		Biofuel production t/ha		Biofuel l/ha	
			Degrad / aband	Unrest. / rain fed	Degrad / aband	Unrest. / rain fed	Degrad / aband	Unrest. / rain fed	Degrad / aband	Unrest. / rain fed
Crops for Biodiesel production	*Euphorbia lathyris*	Med			2.5	4	0.81	1.30	931	1490
	Ricinus communis	High			1	1.5	0.32	0.47	362	543
	Jatropha curcas	High	300,000		5	8	1.08	1.73	1241	1986
	Brassica rapa	Med			2	3	0.58	0.86	662	993
	Aleurites fordii	High			3.6	5.8	0.78	1.25	894	1440
Crops for Bioethanol Production	*Canna edulis*	High	50,000	50,000	30	60	1.44	2.88	1800	3600
	Manihot esculenta	High	100,000		10	15	1.20	1.80	1500	2250
	Saccharum officenarum	Med			30	60	1.62	3.24	2025	4050
	Ipomeas batatas	Low			8	20	0.58	1.44	720	1800
	Sorghum bicolor	High			30	45	1.08	1.62	1350	2025

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Climate balance

for Jatropha, Canna & Cassava

Farm operation	Emissions (kg CO_2-eq hm^{-2} yr^{-1})		
	Jatropha	Canna	Cassava
Land use change (estimate of vegetation loss: shrubs; annual average for 20 yrs production)	**-25**	**-15**	**-15**
Debit/Credit from stopping degradation/improvement	**40**	**22.5**	**15**
Pesticides (production)	**-6.5**	**-8.7**	**-13.0**
Irrigation (pumping)	**-12.0**	**-24.0**	**-**
Nitrogen (CO_2-equivalent fert. production)	**-270**	**-810**	**-270**
N (CO_2-equ; manure production)	**-50**	**-150**	**-75**
N_2O emissions (kg CO_2/ha)	**-355**	**-533**	**-266**
Potassium CO_2-equ (kg/ha; fert. production)	**-52**	**-155**	**-78**
Phosphorus CO_2-equ (kg/ha; fert. production)	**-27**	**-81**	**-41**
Transport (flat ~ 5% of world average)	**-50**	**-100**	**-80**
Total CO_2 emissions at field level = total debit	**-807**	**-1854**	**-822**
CO_2-credit from fossil fuel	**3397**	**2861**	**2384**
Balance	2589	1007	1562
35% CO_2-savings on fossil fuel	**-1399**	**-1178**	**-982**
Balance (credit for processing)	**1191**	**-171**	**580**
Process emissions/ha (estimate for biodiesel based on Jungmeier et al. 2008)	**-844**	**?**	**?**
Total CO_2 emission reduction/ha	**347**	**?**	**?**
Total CO_2 emission reduction (%)	43.7	**?**	**?**

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WP4: Proof of the reliability of the top-down identification of areas for biomass production

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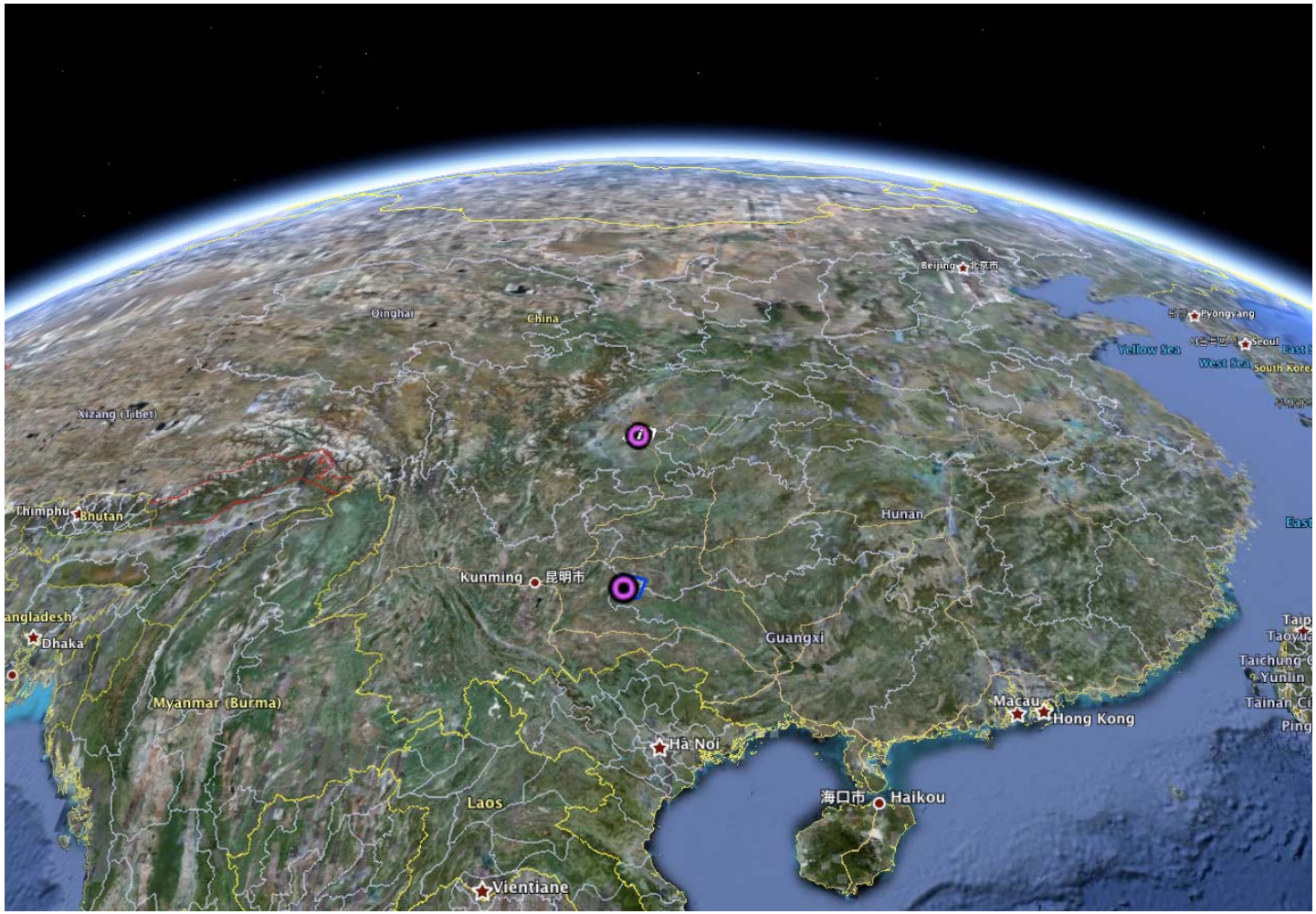

2 Field Sites had been filtered out: Sichuan and Guizhou (see here in Google Earth)

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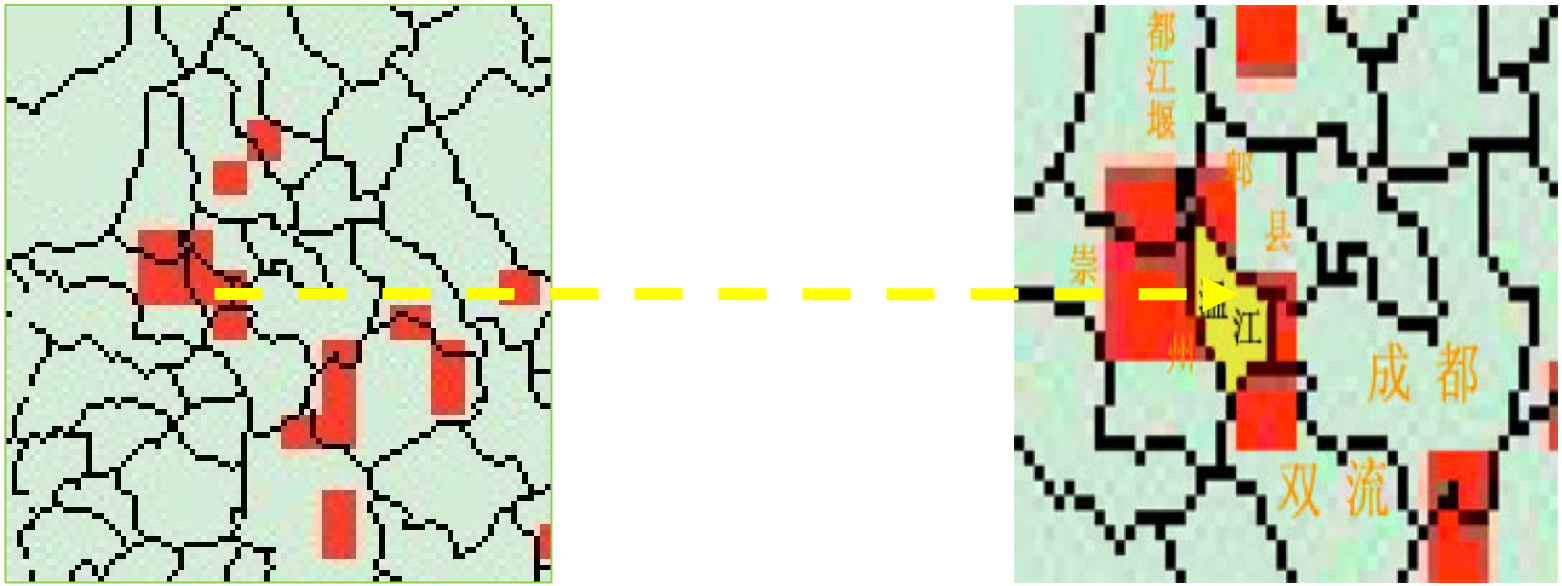
Wenjiang District, Sichuan

- **Identification** of **4-6 clusters** of suitable areas neighboring Chengdu
- County with maximum cluster coverage selected



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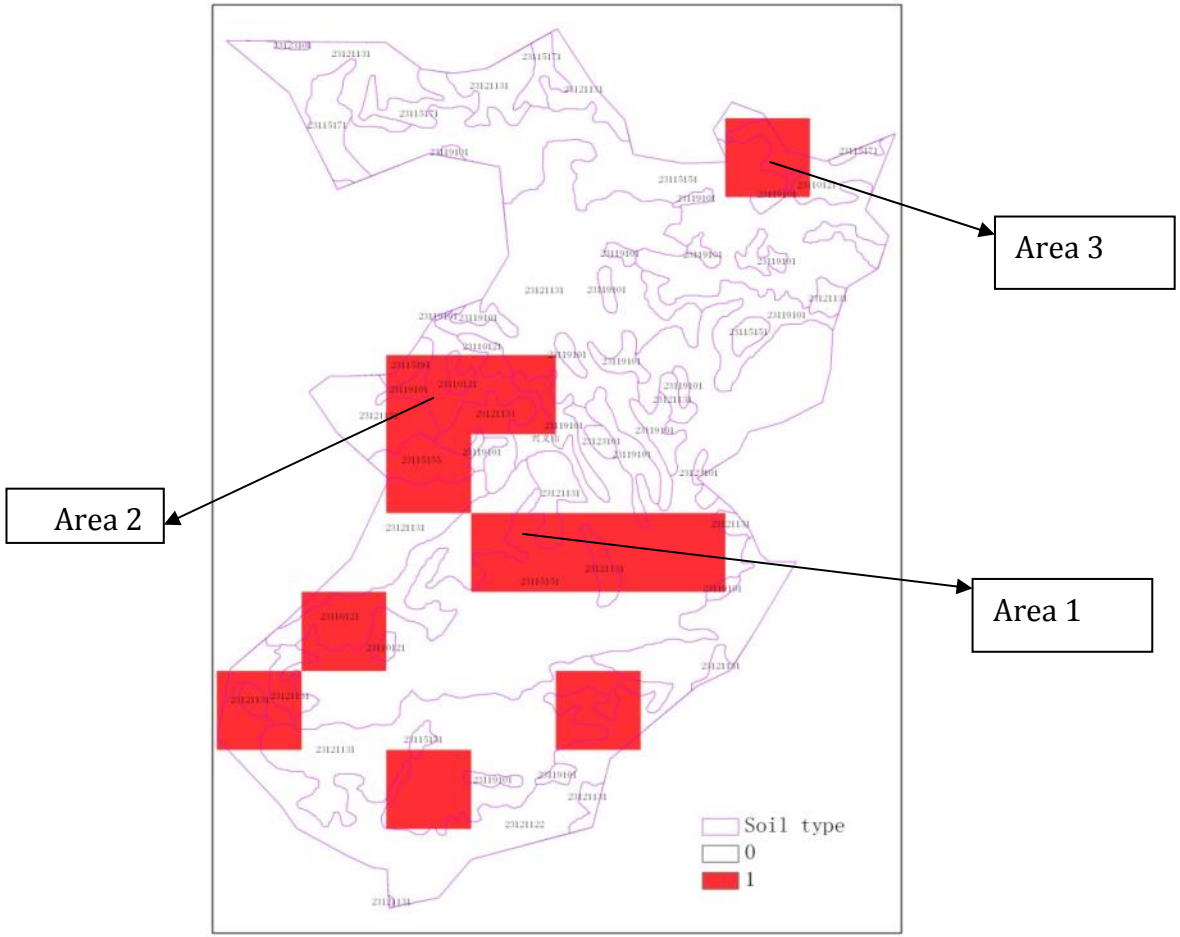
Wenjiang District/ Sichuan:

- **The most reliable parameter was the one from slightly to severely degraded land**
  - ➢ Most of the land in Wenjiang District is slightly degraded
- **Some of the used maps/data are not up to date, resulting in a partly wrong allocation of different land-use types/groups**
  - ➢ Ornamental tree planting is an increasing land-use type that has not been Top-down identified
  - ➢ Local biodiversity protection zoning was introduced in 2009, not yet reflected in any database
- **The urbanization rate and other socio-economic changes especially in China have not been taken into consideration too little**
  - ➢ The Top-down analysis was not able to indicate the high urbanization rate of Wenjiang District (data used from 2000 to 2006)

Xingyi City, Guizhou

- Visited **Areas 1-3** inside different 8km^2 pixels



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Xingyi City/ Guizhou:

- **Relatively high pressure on (agricultural) land**
  - ➢ Symptoms like planting of maize on steep slopes in some locations
  - ➢ In Karst regions of the south, groundwater is by far not abundant
- **In general there is a rather increasing use of energy crops in Guizhou province**
  - ➢ Insufficent production technologies result in higher costs for biofuels
  - ➢ Pilot project area in the framework of the Sino-German sustainable fuel parternership
- **The remote GIS-approach (refer to WP2) has been confirmed by the on-site field trip**
  - ➢ The areas 1-3 which are defined as slightly degraded areas have been identified in reality as such
  - ➢ Degraded areas are scattered and sometimes non-coherent

Xingyi City – Feedback to WP 1-3

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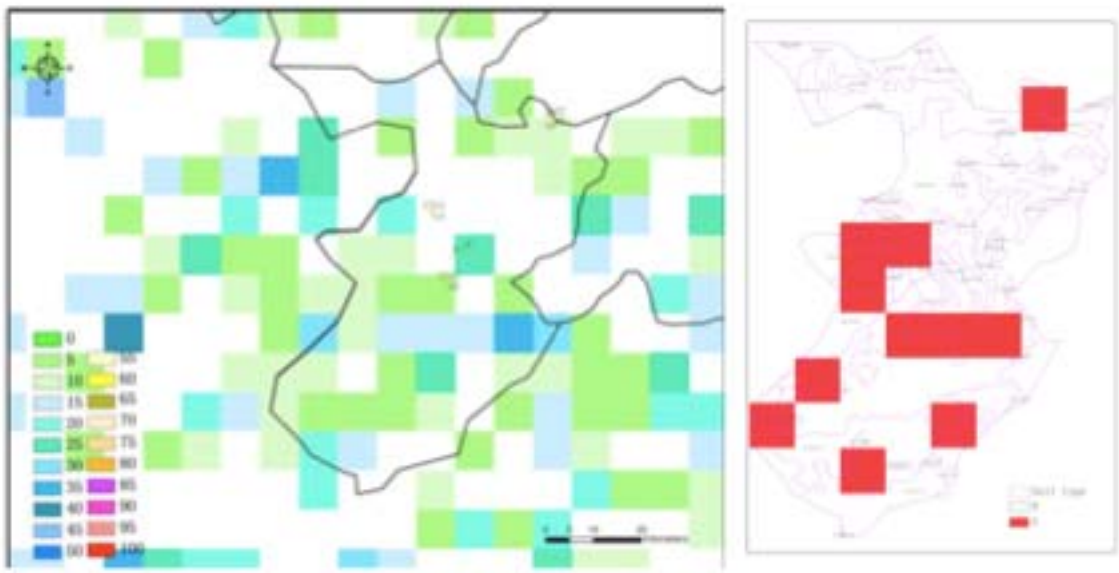
- **Fine-tuned map** of degraded land Xingyi City devided into 5% degradation intensity steps



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WP5: Comparison of Data with Globally Available Results

1. In many cases the global data sets are built on the national datasets.
2. Alternatively, the national data sets are clipped from the global remotely sensed data sets.
3. Projection Issues- Projecting Global Datasets with conventional GIS software results in significant error on commercial software

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Sichuan Ground Control Point (WP3 & 4): N 27 E 104

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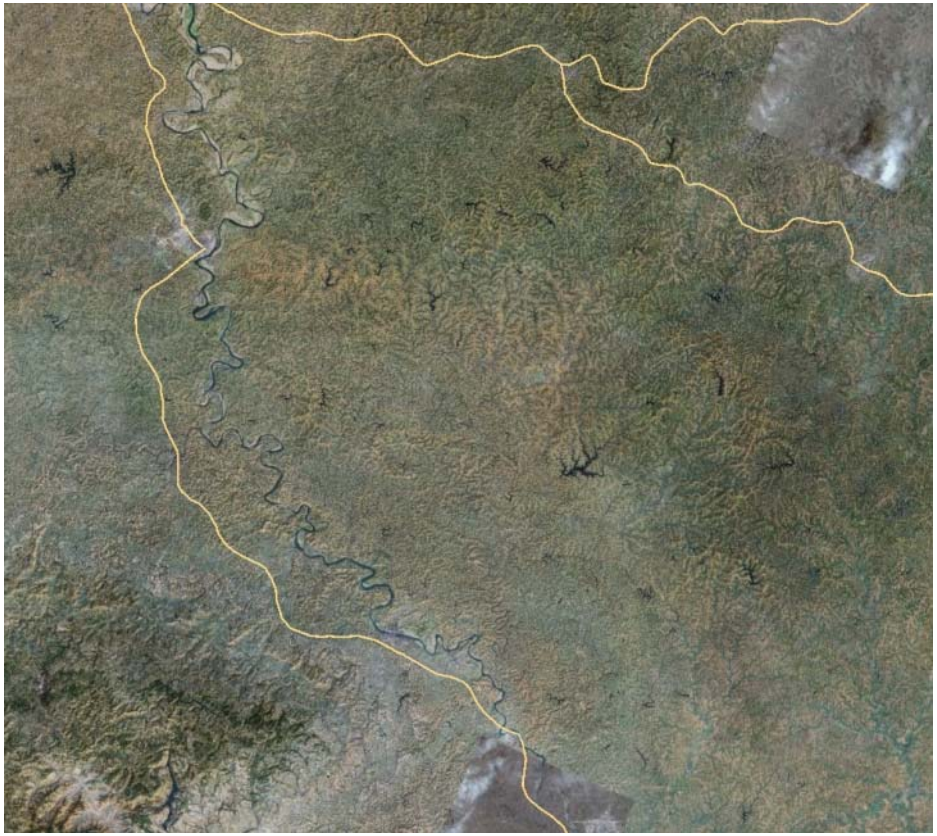
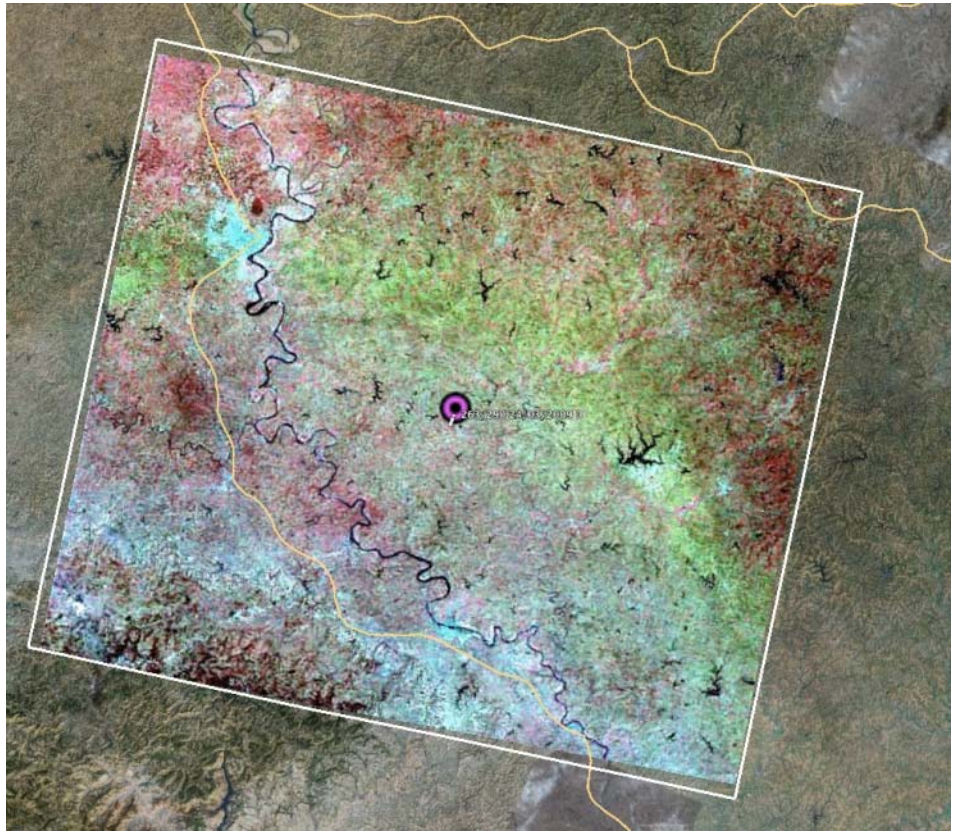


Quickbird- True-Colour



SPOT Overlay
Clearly showing vegetation without extensive image analysis

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Guizhou Ground Control (WP3 & 4): N 25 E 105

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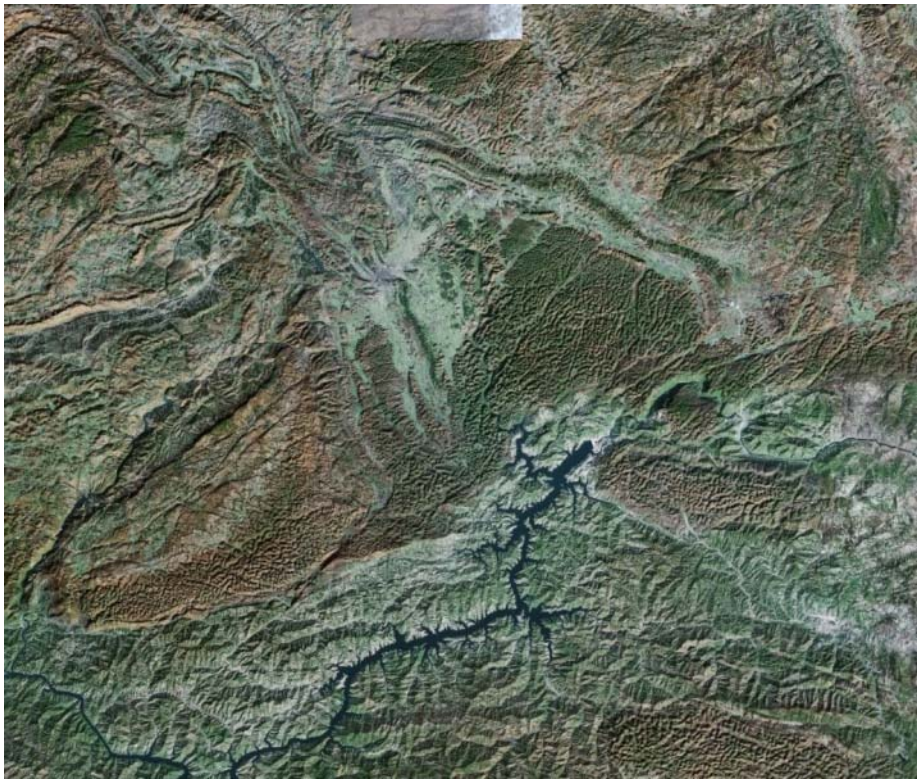

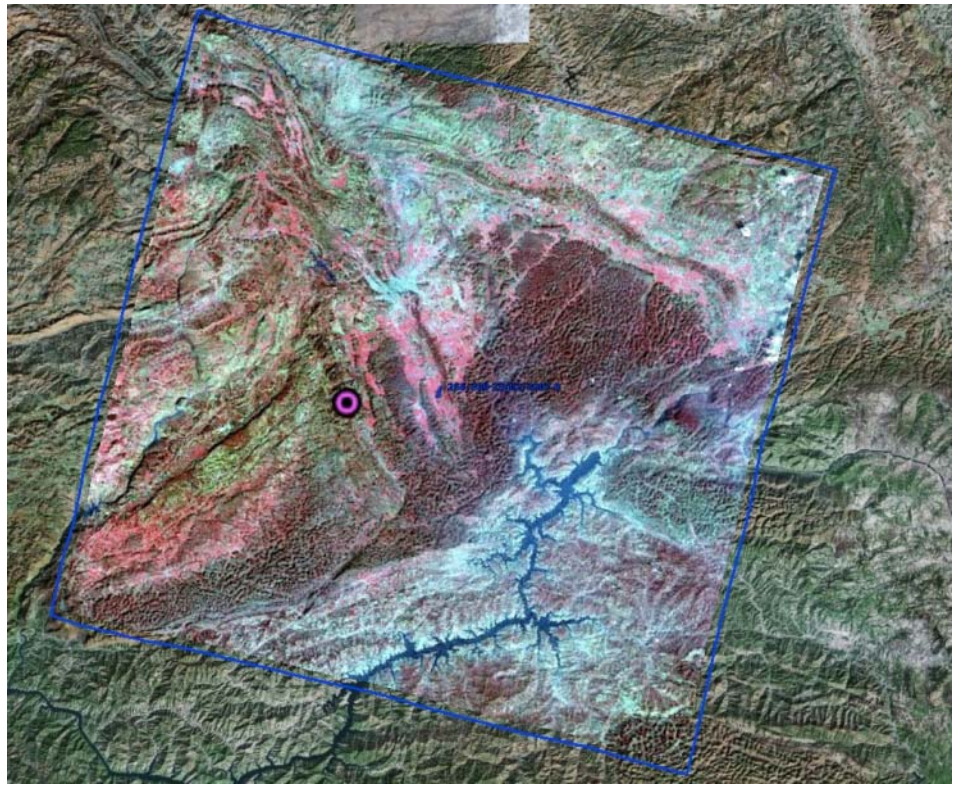

Remote Sensing Data manipulated
with SPOT overlay on baseline Quickbird image

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WP5: Comparison of Data with Globally Available Results

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Regional and global raster data yield varying areas when projected in different equal area projections.

Problems with projection, resolution, latitude

- 1 km or less, any equal area projection is okay
- 1 to 8 km, Molleweide shows best accuracy
- 16 to 25 km, Eq-Cylindrical and Goode better
- 50 km, Molleweide best
- Overall, Molleweide a good alternative for the global level assessments, but not useful for ground truthing

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WP5: Problems with Scale, Latitude and Projection of Global and Regional Datasets- Lambert, Molleweide and Goode

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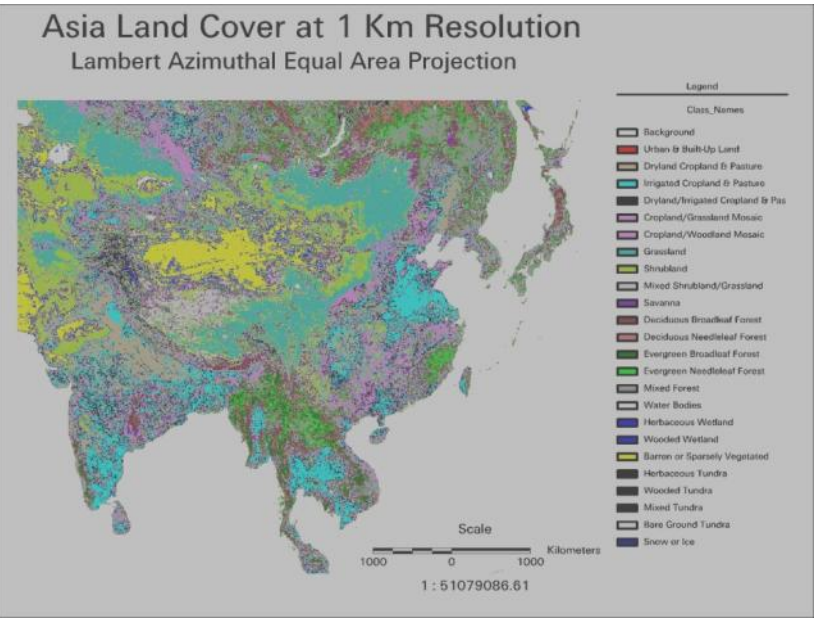

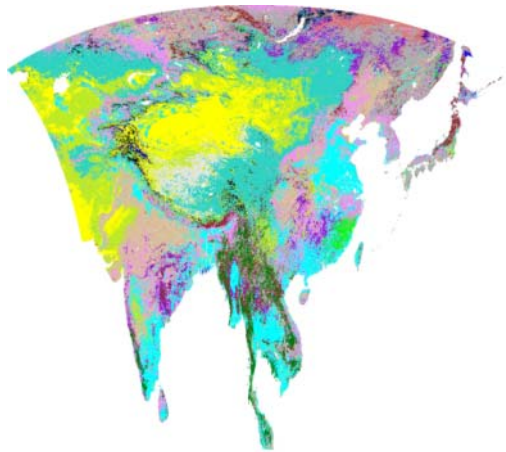

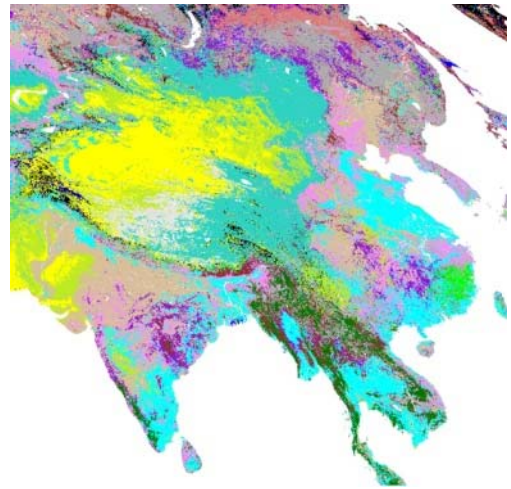

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WP 5 - Provision of GIS Data for Mapping of AVALABLE Degraded and Biodiversity Relevant Land on National and Sub-national scale

RESULT:
positive List of Habitats for Biomass Production

Work Package Data Provided in Shapefiles and TIFF files on disk and online storage, by JNP and CAAS.

http://download.spotimage.fr/~OEKO/

All other shapefiles, DEM, Global Datasets, National Dataset used as core layers were stored online at: www.adrive.com

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Conclusion (1)

Projecting global datasets is heavily dependent on the choice of classification system (Equal-Area, equal intensity …)

Projection of Global Datasets with conventional GIS software results in error. Errors affect global models and need to be corrected for- this is a complex process

Extensive Computation Times and Cost, need for professional enterprise software, hardware and data.

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Conclusions (2)

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- Methods by Bai and Dent (2008) as well as Field et al. (2007) are utile for detection of suitable land for biomass production
- More refined (high resolution) approach needed.
- Potentially suitable areas possibly overestimated by bioenergy developers
- *Jatropha curcas* has potential to pass the EU 35% emission reduction criterion and to be competitive

If jatropha is to become a practical biofuel feedstock, more research is needed on suitable germ plasm and yields under various conditions and scales, and markets need to be established to promote sustainable development of the crop.

- Diverse and multipurpose energy cropping systems useful for degraded land rehabilitation

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