

Livestock Waste Management in East Asia **LWMEA** (GCP/RAS/215/WBG)

The World Bank

Global Environment Facility

The Food and Agriculture Organization

DECISION SUPPORT TOOL FOR SPATIAL PLANNING AND DECISION MAKING

Technical support

**Consultant report on the joint project mission held in
SE Asia from 13th to 24th April 2007**

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Summary

Together with delegations of the World Bank and FAO, who carried out a project supervision mission, the consultant Gerrit Carsjens and FAO-LEAD officer Pierre Gerber carried out a technical support mission to Vietnam, Thailand and Guangdong from April 13 to 24 2007. In each country the mission comprised:

1. A workshop with invited experts on the possibilities and needs of a spatial Decision Support Tool (DST) in the form of a GIS computer model.
2. Expert consultations about potential collaborations.

Important conclusions from the workshops can be summarized as follows:

- There is a keen interest for a spatial DST in all the countries. However it will have to take into account the needs of users at national as well as the more local level. The DST should be a tool to support strategic planning and decision making at national level as well as decision making on the allocation of livestock farms at the local level.
- The DST

The progress since the last mission

The mission allowed valuable discussions with the project teams on the upcoming activities.

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1. Introduction

This report describes the results of a series of workshops and technical consultation meetings in Vietnam, Thailand and Guangdong Province of China, during a joint mission to SE Asia from 13th to 24th of April 2007. Based on the results recommendations will be provided on the further development of a spatial DST.

1.1. Context of the mission

For the context of this report, the reader is directed to some previous reports prepared in the past two years as well as the project documentation itself.

Carsjens, G.J., Gerber, P., 2007. Technical backstopping spatial decision support tool. Summary report. FAO, GCP/RAS/203/WBG Livestock Waste management in East Asia Project, April 2007, 16 p. The draft summary report of this report.

Carsjens, G.J., 2006. Spatial planning and decision support of livestock production in East Asia. FAO, GCP/RAS/203/WBG Livestock Waste management in East Asia Project, November 2006, 37 p. This report is an updated and revised version of the final report of the preparation phase of the LWMEA project (see below), based on the results of the mission and regional workshop in Hanoi, Vietnam, in October 2006.

Carsjens, G.J., 2004. Spatial planning of future livestock production, Livestock waste management in East Asia. GEF project GCP/RAS/203/WB, Report of the international consultant on Spatial Planning, Land Use Planning Group, Wageningen University, The Netherlands, September 2004, FAO, 2004, 41 p. This report is the final report on spatial planning and decision making of the preparation phase of the LWMEA project, and includes a description of the conceptual framework of a spatial planning DST, based on the experiences of the Area-Wide Integration (AWI) pilot projects.

1.2. Objectives of the spatial DST workshop

The overall objectives of the spatial Decision Support Tool (DST) workshop were:

1. To review and discuss the country specific policy and decision making context and needs for spatial planning of future livestock production;
2. To identify the requirements of a supporting tool and its basic components;
3. To discuss the practical arrangements to be made for developing the tool (operational users, target groups (stakeholders), technical capacity, data requirement and data supply, etc.).

In each participating country a one-day workshop on the context and framework of the spatial DST was organized. Furthermore, technical meetings were held with some dedicated national experts who might have the expertise to contribute to the further development of the spatial DST.

1.3. Itinerary of the mission

The mission schedule with regard to the spatial DST development is presented in Annex 1. In general, the visits to each country included two elements: (a) a workshop to discuss the context, requirements and development of the spatial DST, and (b) technical consultation meetings with key people interested in the development of the DST and/or the required data.

2. Workshop and consultation in Viet Nam

A workshop on the spatial decision support tool (DST) was held on 13 April 2007. Technical meetings were held at Hanoi Agricultural University on 14 April and with experts of the Database and Information System Center of MONRE on 16 April.

2.1. Spatial DST workshop, 13 April 2007

Although the workshop was relevant for policy and decision makers at national and provincial level from the ministries of agriculture, environment and land-use planning, as well as experts and other stakeholders, most participants were representatives of universities. The participants present were:

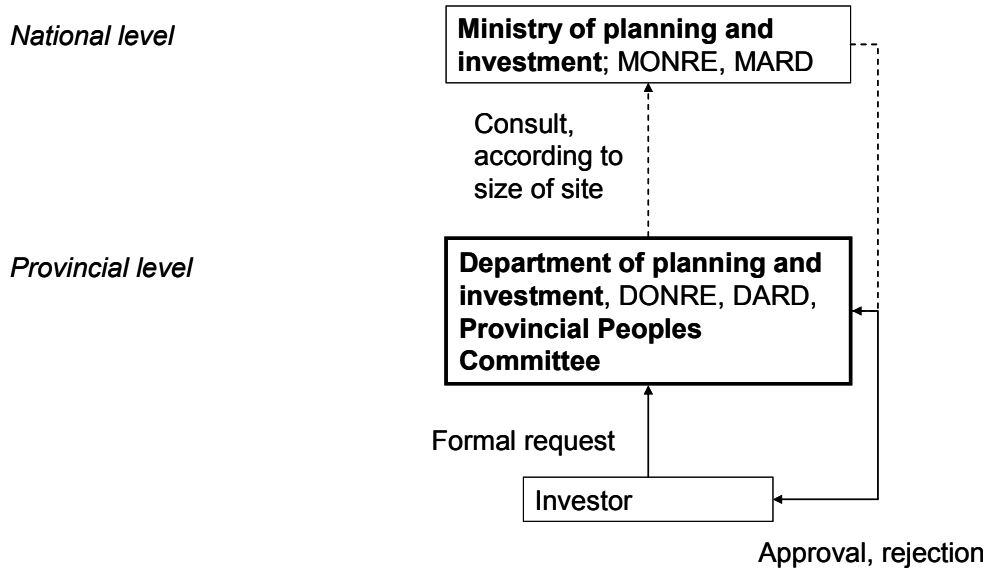
- Ta Hoai Anh, Science and technology information center, Ministry of Science and Technology
- Hoang Tuan Minh, Hanoi University of Agriculture
- Nguyen Tu Siem, Consultant
- Dao Chau Thu, Hanoi University of Agriculture
- Pham Van Cu, National University
- Nguyen Hong Han, Ministry of Science and Technology
- Nguyen Viet Dinh, PMO
- Nguyen Thi Minh Tam, PMO
- Pierre Gerber, FAO-LEAD
- Gerrit Carsjens, Wageningen University

The morning program of the workshop included a general introduction to the LWMEA project, an introduction on the context and framework of the spatial DST, and a demonstration of some results of the spatial analysis with GIS of the AWI project in Thailand. This was followed by a discussion on the country specific goal and need for a spatial DST. The general conclusion from the discussion was that a spatial DST as described in the introduction will be relevant and important to support and strengthen policy and decision making in Vietnam at both the national and more local levels, as well as for capacity building and training at universities.

The afternoon session focused in more detail on the country specific policy and decision making context, and aimed to (1) identify and discuss the decision making procedure, (2) the operational users of the tool and its output or products, and (3) the relevant ministries, departments and other stakeholders that need to be involved in setting the policy objectives and criteria. The results and conclusions are presented below.

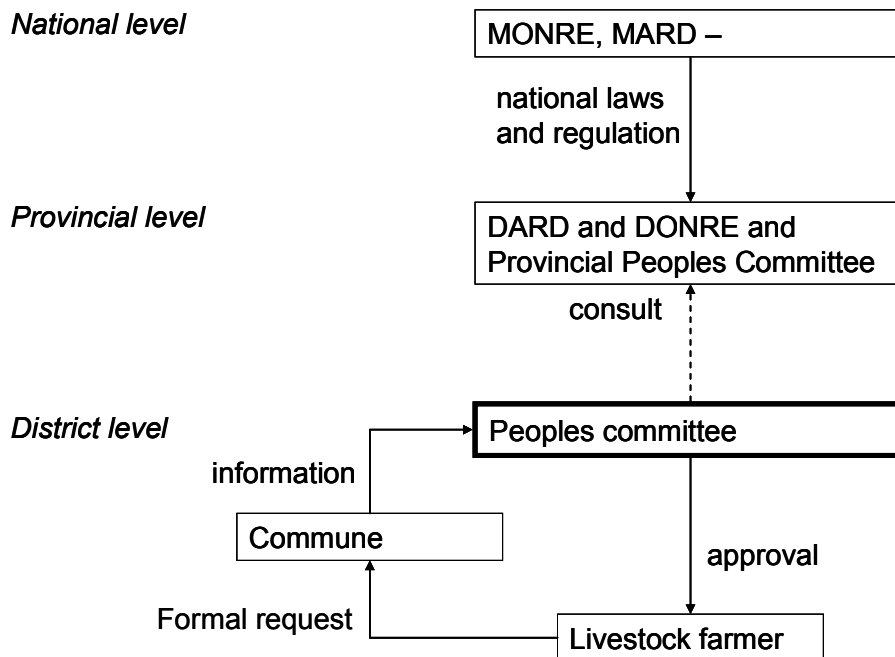
1. *What is the decision making procedure in which the DST should be used?* The discussion started with the decision making scheme that was drawn during the preparation phase of the LWMEA project, as presented in the report “Spatial planning and decision support of livestock production in East Asia” of November 2006. It was concluded that this scheme was not appropriate, and instead two other schemes were drawn, one for the establishment of new large commercial livestock farm, e.g. joint ventures and another for small farms (< 200 pigs).

Large commercial farms; joined ventures



Large farms (> 200 pigs) are regarded as enterprises under the business law, and decisions are primarily been made at province level. Therefore, the department of planning and investment (DPI), and the provincial peoples committee (PPC) hold a key position in the decision making procedure (in bold). In some situation the province needs to consult the ministries at national level, based on the size of the enterprise. For small farms the decisions are primarily been made at district level by the peoples committee. The committee sometimes consults the province, and also has to comply with national laws and regulation in their decision making.

Small farms



2. *What should be the products of the DST and who are the users of these products?* The required type of products of the spatial DST and the potential users of these products were discussed and identified. The products that were identified are (1) printed maps with an explanatory manual, and (2) the spatial DST itself. Based on these products the users of these products were identified, and are listed below. The table also includes a column with specific actions that are needed, e.g. training. The main users of the spatial DST that were identified are MONRE, MARD, and possibly the DONRE and DARD of some selected provinces. MPI, DPI and the PPC were identified as users of the output maps of the spatial DST, and not the spatial DST itself.

Users	Products		What is needed?
	Printed maps (output of DST) with explanatory manual	GIS-Application (DST)	
MONRE	X	X	Training
MARD: NIAPP, NIAH	X	X	Training
MPI: Department of SME management	X		
Ministry of Trade, Department of business promotion	X		
Provincial Peoples Committee PPC	X		
DONRE	X	X Selected provinces	Training of selected provinces ESRI-ArcGIS for selected provinces
DARD	X	X Selected provinces	Training of selected provinces
DPI	X		
Association of medium and small enterprises	X		
Universities – Technical Univ. Agricultural Univ.	X	X Partners in the project – supply of high-quality trainers	Supply CD-ROM
District Peoples Committee (DPC)	X		
Animal Husbandry Union	X		

NIAPP = National Institute for Agricultural Planning and Projection
NIAH = National Institute for Animal Husbandry

3. *What ministries, departments, and other stakeholders should be involved and for what purpose?* The purposes to involve ministries, departments and other stakeholders were identified as (1) data provision, (2) setting policy objectives, (3) setting technical criteria and (4) providing training. Who should be involved for these purposes was then discussed and the results are presented in the table below. MONRE, MARD and MPI were identified as important data holders. The results also include an extensive list of ministries, departments, NGOs and other to be invited in the policy objective and/or technical workshops of the project.

Stakeholders/institutions	Purpose			
	Data provision	Policy objectives setting	Technical criteria setting	Training
Ministry of Natural Resources and the Environment (MONRE)	Digital maps (topography, admin, hydrology, soil, land use, water sheds, river basin, ...) Statistical data (rainfall, climate, population, economic, ...)	X	X	
Ministry of Agriculture and Regional Development (MARD)	Statistical data of agricultural production (crops, animals, ...)	X	X	
Ministry of Planning and Investment (MPI)	Master plans at national and regional level – paper map	X		
General Department of Statistics of MPI	Statistical yearbooks			
Provincial and District Peoples Committee	Master plans from province to district level – paper maps. Slaughterhouses (DARD)	X		
Animal Husbandry Association	Farm- and livestock enterprises data, types of farms	X	X	
Association of Animal Feed	Feed mills	X	X	
University			X	X
National and international experts			X	X
Environmental NGO		X	X	X
Ministry of Health	Community health		X	
Vietnam Farmer Union		X		
<i>And others</i>				

Finally, a questionnaire was discussed among the participants of the workshop. During the morning session it already showed that most participants were randomly invited and not familiar to the LWMEA project. This is reflected in the answers to the first two questions, but also in the questions related to identifying the relevant issues in the context of the spatial DST. Some recommendations were made with respect to the next workshops that might be organized, and especially the invitation and preparation of participants should be improved. The results of the questionnaire are listed below.

	Yes	Relatively	No
1. Were you informed about the workshop sufficiently in advance?			X
2. Was the purpose of the workshop clear to you before the event?			X
3. Has the purpose of developing a spatial DST become clear to you during the workshop?	X		
4. Do you find the DST useful and relevant for the problems related to livestock development in your country?	X		

5.	Did you find the workshop useful for expressing your views?	X		
6.	Do you feel that you could voice your opinion?		X	
7.	Does the output of the workshop reflect the views and ideas of everyone?		X	
8.	Do you think the workshop clearly identified the issues in your field of expertise that should be included in the DST?		X	
9.	Do you have any other comments or ideas for the further development of a spatial DST or the LWMEA project in general?			
	<ul style="list-style-type: none"> • The project is necessary for rural development, not only from technical point of view, but also for strategic reasons, the development of livestock production and required policy making • Invitation of participants was too limited; participants of MONRE and MARD (at the least) should have been invited for this discussion • Improve the dissemination of what this project is about • Organize this meeting next time at the office of a ministry or university (the hotel is too expensive) • Publish about this project and the Spatial DST in specialized Vietnamese papers and journals (note: English website on the project has been constructed by FAO at www.lwmea.org). 			

2.2. Technical consultation meetings

The technical meetings aimed to further discuss the technical issues with respect to the spatial DST, especially the technical development of the spatial DST (regional activity), the development of a database management system (DBMS) (country-specific activity) and providing training in the use of the spatial DST (country-specific activity). Two meetings took place, at Hanoi Agricultural University and MONRE.

Hanoi Agricultural University, Sustainable Agricultural Research and Development Center (SARDC), 14 April 2007

The participants in the meeting were:

- Prof. Dao Chau Thu, Vice Director
- Mrs. Truong Thi Toan, Researcher and lecturer
- Mrs. Le Thi Giang, Lecturer, Faculty of Land and Environment, Informatics
- Mr. Luyen Huu Cu, Lecturer, Faculty of Land and Environment, Soil science
- Mr. Minh, researcher
- Mrs. Ngoc Lan, researcher
- Mr. Pierre Gerber (FAO-LEAD)
- Mr. Gerrit Carsjens (Wageningen University)

The results and conclusions from the meeting were:

- HAU is involved in research and training in GIS and spatial planning at MSc and PhD level; SARDC is 10 years old
- Best example of applying GIS: project that uses Remote Sensing data to identify the agricultural and ecological situation of areas; complex situation, need to combine RS and aerial photos.
- HAU mainly uses ArcView software, and has no ArcGIS licenses
- Many former students of HAU are employed by DONRE; this might provide a good network of contacts
- A potential problem for the DBMS will be different formats of data that currently exist between the different provinces in Vietnam

- At MONRE a project currently aims to generate a uniform soil map at district level for the whole of Vietnam.
- Vietnamese Academy of Agricultural Sciences (VAAS) has data on land use and crops, while livestock data is the responsibility of the National Institute for Animal Husbandry (NIAH).
- HAU is primarily interested in cooperating in the training part of the spatial DST.

Ministry of Natural Resources and the Environment (MONRE), Database and Information System Center (DISC), 16 April 2007

The participants in the meeting were:

- Mr. MSc Pham Le Thanh Son
- Mrs. Ly Thu Hang
- Mr. Pierre Gerber (FAO-LEAD)
- Mr. Gerrit Carsjens (Wageningen University)

The results and conclusions from the meeting were:

- DISC (40 people) is a part of the Remote Sensing center (300 people) of MONRE.
- The RS center is involved in image processing and base map production.
- MONRE is providing training in GIS and hard- and software to the DONRE's, funded by another project of the World Bank.
- At MONRE a Land Information System is being set up. This system is set up by DISC, programmed in Visual Basic (VB) and in ArcGIS database format. However, own GIS software is being developed and used, as well as MapInfo software. The Land Information System includes data up to the local level.
- A more simple land use management model at province level will be distributed among the DONRE's.
- Currently only geo-data of urban areas are available. These data include soil, land use, water, road, elevation and other data.
- A map with administrative boundaries is available, including national to commune level.
- Given the current lack of geo-data it will be important to focus first at some selected provinces in the Hanoi and Ho Chi Min City region.
- It will be important to establish a link between the Land Information System and the spatial DST of the LWMEA project, consequently making DISC an important partner. Further contacts will be made by the RFO, in coordination with the PMO .

3. Workshop and consultation in Thailand

A workshop on the spatial decision support tool (DST) was held on 18 April 2007. Technical meetings were held at the Institute of Space Knowledge Development, Geo-Informatics and Space Technology Development Agency (GISTDA) on 19 April and with experts of the Asian Institute of Technology (AIT) on 20 April.

3.1. Spatial DST workshop, 18 April 2007

Although the workshop was relevant for policy and decision makers at national and provincial level from the ministries of agricultural, environment and land use planning, as well as experts and other stakeholders, most participants were from the Department of Livestock Development (DLD) and Provincial Livestock Office (PLO) of the Ministry of Agriculture and Cooperative. The participants present were:

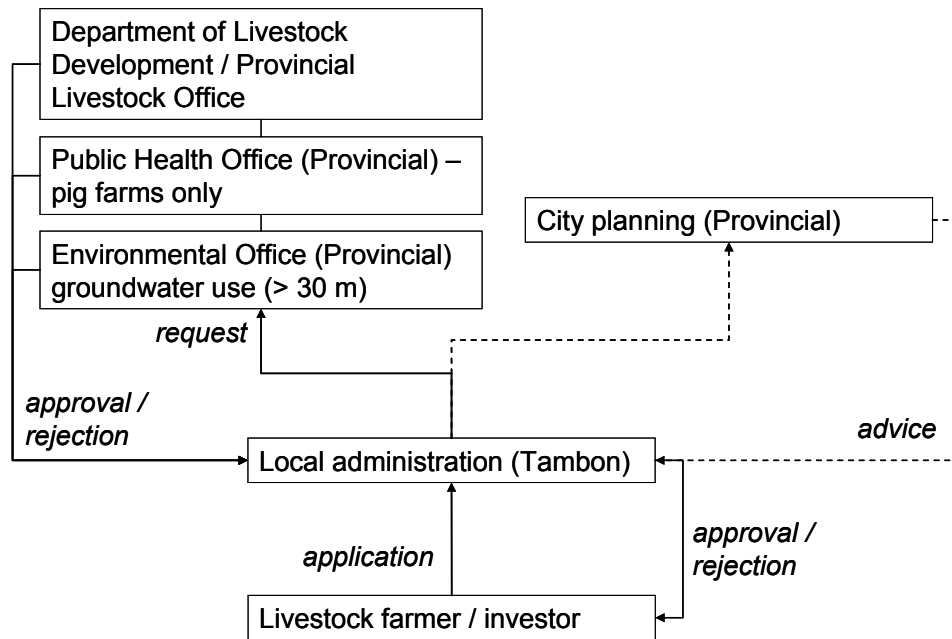
- Mr Adisorn Chanprapalert, Department of Livestock Development
- Mr. Surachet Eungjanpany, Chonburi Province Livestock Office
- Mr. Anan Singhata, Chachgensao Province Livestock Office
- Mr. Supachai Skawsang, Geo-Informatics and Space Technology Development Agency (GISTDA)
- Mr. Suppawate Thongprayoan, Department of Groundwater
- Mr. Thanis Damtongwatamapotin, Department of Vet Public Health, Faculty of Vet. Science, Chulalongkorn University
- Mr. Sumet Mettasart, Nakhonpathorn Provincial Livestock Office
- Miss Suchada Susutthi, Ratchaburi Provincial Livestock Office
- Miss Kunlayanee Boonjongruk, Department of Livestock Development
- Mr. Chairat Worasri, Department of Livestock Development
- Mr Pierre Gerber, FAO-LEAD
- Mr Gerrit Carsjens, Wageningen University

The morning program of the workshop included a general introduction to the LWMEA project, an introduction on the context and framework of the spatial DST, and a demonstration of some results of the spatial analysis with GIS of the AWI project in Thailand. This was followed by a discussion on the country specific goal and need for a spatial DST. The discussion on the country specific needs focused at the relevance of macro and micro scale output maps. The participants from the Provincial Livestock Office stressed the need for more detailed maps at land use level (micro level) in order to be able to connect the output of the spatial DST to the regular land use plans (approximately 1:50.000 scale).

The afternoon session focused in more detail on the country specific policy and decision making context, and aimed to (1) identify and discuss the decision making procedure, (2) the operational users of the tool and its output or products, and (3) the relevant ministries, departments and other stakeholders that need to be involved in setting the policy objectives and criteria. The results and conclusions are presented below.

1. *What is the decision making procedure in which the DST should be used?* The decision making scheme from the preparation phase of the LWMEA project (as presented in the report “Spatial planning and decision support of livestock production in East Asia” of November 2006) was discussed. It was concluded that this scheme is not appropriate, and instead another scheme were drawn, as presented below.

Decision making procedure



The local administration at Tambon level plays a key role in the decision making procedure, as well as the Environmental Office and Public Health Office at Province level administration.

DLD identifies new livestock production areas, and is therefore an important user of the spatial DST. However, DLD does not work directly with local administration, only with a livestock officer at provincial level. Therefore, for the implementation of the output also Tambon local administration and the Ministry of City Planning and Interior were identified as important potential users of the output.

Three years ago a National Pig Board was established, that is involved in policies concerning raising and processing pigs. This advisory board includes representatives of other relevant organizations.

2. *What should be the products of the DST and who are the users of these products?*

The required type of products of the spatial DST and the potential users of these products were discussed and identified. The products that were identified are (1) printed maps at provincial level, 1:50.000 scale, (2) printed maps at national level, 1:100.000-1:500.000 scale, and (3) the spatial DST itself. Based on these products the users of these products were identified, and are listed below. The table also includes a column with specific actions that are needed, e.g. training. The main users of the spatial DST that were identified are DLD and PLO, the Ministry of natural resources and environment, and universities.

Users	Products			What is needed?
	Printed maps at provincial level 1:50.000	Printed maps at national / regional level 1:100.000 – 1:500.000	GIS-Application (DST)	
DLD – DG office		X		
DLD – Bureau of livestock standards and certification			X	Training GIS and DST
DLD - Bureau of disease control			X	Training GIS and DST

DLD - Bureau of Live-stock development and technology transfer		X	X	Training GIS and DST
DLD – IT Center			X Provide training	Training DST
DLD regional		X		
PLO	X			
Ministry of Natural Resources and Environment – Department of Pollution control		X	X	?
Ministry of Natural Resources and Environment – Department of groundwater		X	X	?
National Pig Board (advisory board)		X		
Governor office	X			
City Planning Provincial Office	X			
Local District Organization	X			
Farmers	X			
Universities – Master level			X For training purposes	

DLD = Department of Livestock Development

PLO = Provincial Livestock Office

3. *What ministries, departments, and other stakeholders should be involved and for what purpose?* The purposes to involve ministries, departments and other stakeholders were identified as (1) data provision, (2) setting policy objectives, (3) setting technical criteria and (4) providing training. Who should be involved for these purposes was then discussed and the results are presented in the table below. DLD/PLO and Land Development Department were identified as important data holders, but many other departments/organization are holding specific other data. The results also include an extensive list of ministries, departments, NGOs and other to be invited in the policy objective and/or technical workshops of the project.

Stakeholders/institutions	Purpose			
	Data provision	Policy objectives setting	Technical criteria setting	Training
DLD – DG office		X		
DLD – Bureau of livestock standards and certification			X	
DLD - Bureau of disease control			X	
DLD - Bureau of Livestock development and technology transfer	Locations of livestock markets		X	
DLD – IT Center	Quarantine stations			X
DLD regional			X	
PLO	Farm locations, feed mills, slaughterhouses (GPS), Livestock statistics (animal population)		X	
Ministry of public health			X	

Pig producer association		X	X	
CP group			X	
Betagro group			X	
Ministry of Agriculture and co-operative - Office of agricultural economics	Agricultural statistics	X	X	
Katsesat University			X	X
Chulalongkorn University				X
NSDB National Social and Economic Development Board	Poverty data and rural development	X	X	
Land Development Department - Soil survey and classification division	Soil maps, Land use maps, elevation data	X	X	
Department of Agriculture			X	
Ministry of Natural Resources and Environment – Department of Pollution control			X	
Ministry of Natural Resources and Environment – Office of environmental planning and policy	Watershed boundaries	X		
Ministry of Natural Resources and Environment – Mangrove and wetland department			X	
Ministry of Natural Resources and Environment – Groundwater department	Groundwater level		X	
Environmental NGOs		X		
Ministry of transport - Road and highway department	Road infrastructure			
Prime Minister Office – Department of budget		X		
Geo-Information and Space Technology Development Agency	Satellite images (LandSat support)			X
Royal Irrigation Department	Water, streams, channels, river basins		X	
Ministry of Defense - Military Map Department	Aerial photos (1:5.000 for free)			

Finally, a questionnaire was discussed among the participants of the workshop. The results of the questionnaire are listed below. The participants stated that they were not informed well enough in advance to the workshop about its purpose. Some recommendations were made with respect to providing more detailed information on the spatial DST preparation.

	Yes	Relatively	No
1. Were you informed about the workshop sufficiently in advance?	X		
2. Was the purpose of the workshop clear to you before the event?			X
3. Has the purpose of developing a spatial Decision Support Tool (DST) become clear to you during the workshop?	X		
4. Do you find the DST useful and relevant for the problems related to livestock development in your country?		X (needs to be more detailed)	

5. Did you find the workshop useful for expressing your views?	X		
6. Do you feel that you could voice your opinion?	X		
7. Does the output of the workshop reflect the views and ideas of everyone?	X		
8. Do you think the workshop clearly identified the issues in your field of expertise that should be included in the DST?		X	
9. Do you have any other comments or ideas for the further development of a spatial DST or the LWMEA project in general? <ul style="list-style-type: none"> • Emphasize the criteria identification, classes and weights • Provide more background information on the DST purpose and functionalities 			

3.2. Technical consultation meetings

The technical meetings aimed to further discuss the technical issues with respect to the spatial DST, especially the technical development of the spatial DST (regional activity), the development of a database management system (DBMS) (country-specific activity) and providing training in the use of the spatial DST (country-specific activity). Two meetings took place, at Institute of Space Knowledge Development and the Asian Institute of Technology.

Institute of Space Knowledge Development, Geo-Informatics and Space Technology Development Agency (GISTDA), 19 April 2007

The participants in the meeting were:

- Ms Supapos Polngam, Director of Institute of Space Knowledge Development
- Mr. Anusorn Rungsipanich, Chief of GIS Data Application Sub-division
- Mr. Supachai Skawsang, Geo-Informatics scientist
- and other representatives of GISTDA (to be completed)
- Mr. Pierre Gerber, FAO-LEAD
- Mr. Gerrit Carsjens, Wageningen University

The results and conclusions of the meeting were:

- GISTDA is a public organization that is half private funded from projects
- GISTDA provides an annual training program for DLD people in GIS (ArcGIS) and RS (Geomatica)
- GISTDA is primarily interested in cooperating in the training part of the spatial DST, but would also be interested in the more detailed theoretical model and programming part of the spatial DST.

Asian Institute of Technology (AIT), 20 April 2007

The participants in the meeting were:

- Mr. Dr. Oleg V. Shipin, Associate Professor, Environmental Engineering and Management, School of Environment, Resources and Development
- Mr. Nitin Kumar Tripathi, Associate Professor, Remote Sensing & GIS, School of Engineering and Technology (SET)
- Mr. Gerrit Carsjens, Wageningen University

The results and conclusions of the meeting were:

- AIT is an international institute with faculty from 47 different countries, primarily funded by scholarships and research programs.

- AIT includes a GIS group that has extensive experience in SDSS programming (including ArcGIS, Visual Basic and VBA), DBMS construction and training support.
- The average costs of a research associate for e.g. programming are approximately 600 US\$ per month.
- AIT is interested in all three components: the programming of the spatial DST, the DBMS construction, and also supporting the training.

4. Workshop and consultation in Guangdong

A workshop on the spatial decision support tool (DST) was held on 23 April 2007, and a technical meeting with a representative of the Environmental Protection Bureau (EPB) – Environmental Monitoring Center on 24 April.

4.1. Spatial DST workshop, 23 April 2007

Although the workshop was relevant for policy and decision makers at national and provincial level from the ministries of agriculture, environment and land-use planning, as well as experts and other stakeholders, most participants were representatives of universities. The participants present were:

- Jiang Ping, Guangdong Environmental Protection Bureau (EPB)
- Wu Jun, Guangdong CDC
- Chen Zhengzan, Provincial Environmental Protection Station
- Lin Xiaohong, Guangdong Provincial Livestock Extension Service
- Pierre Gerber (FAO-LEAD)
- Gerrit Carsjens (Wageningen University)

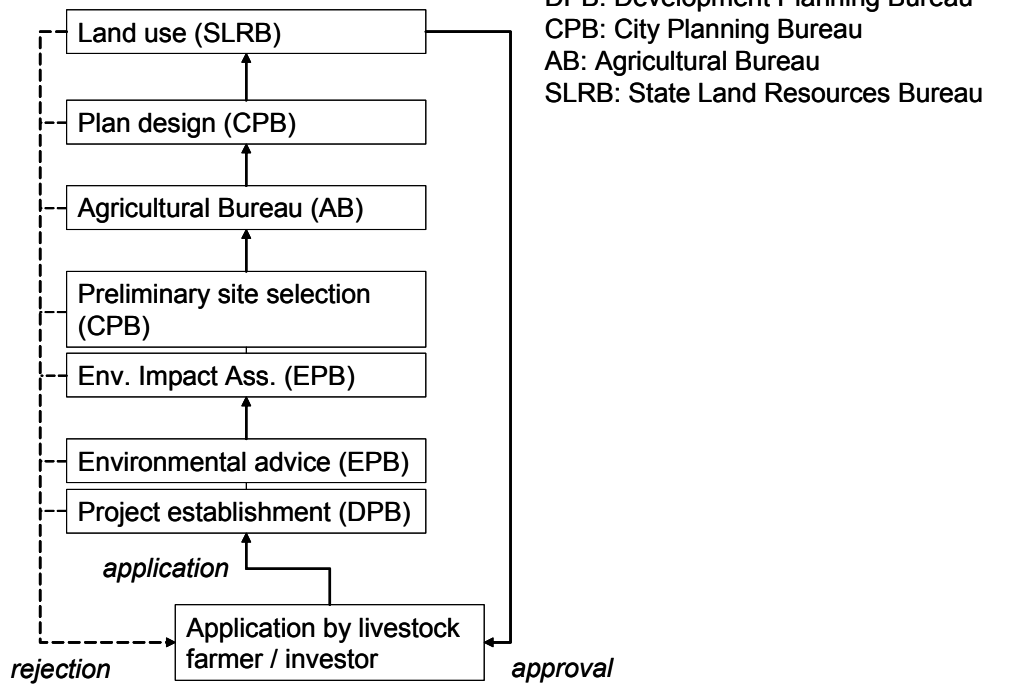
The morning program of the workshop included a general introduction to the LWMEA project, an introduction on the context and framework of the spatial DST, and a demonstration of some results of the spatial analysis with GIS of the AWI project in Thailand. This was followed by a discussion on the country specific goal and need for a spatial DST. The general conclusion was that the presented tool looks practical and useful for decision making at province level, however, the tool can be more useful if it can provide detailed maps at county level to support to local decision making.

The afternoon session focused in more detail on the country specific policy and decision making context, and aimed to (1) identify and discuss the decision making procedure, (2) the operational users of the tool and its output or products, and (3) the relevant ministries, departments and other stakeholders that need to be involved in setting the policy objectives and criteria. The results and conclusions are presented below.

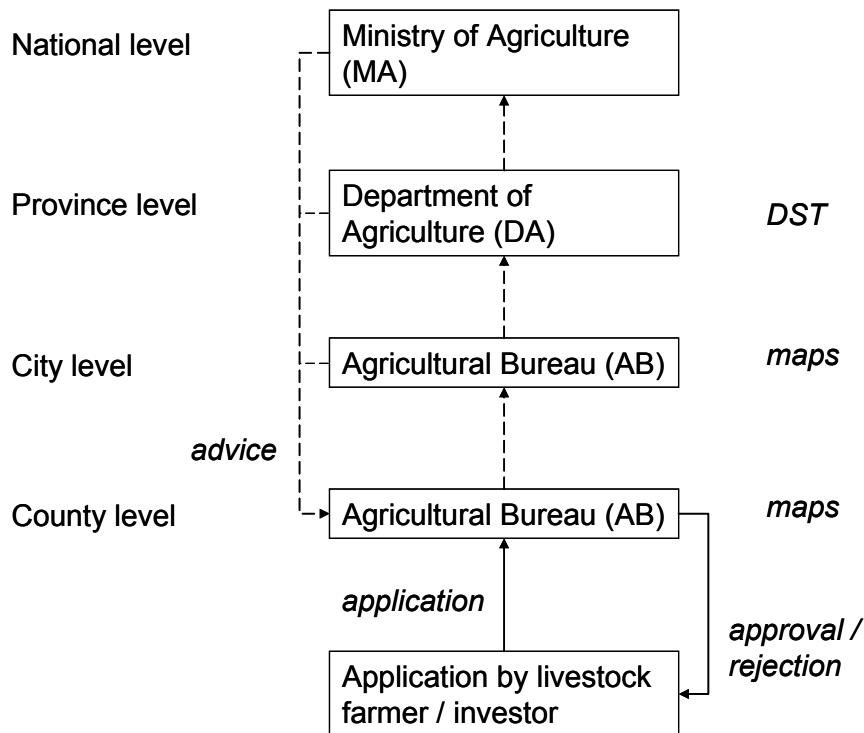
The main results and conclusions were:

1. The decision making scheme from the preparation phase of the LWMEA project (as presented in the report “Spatial planning and decision support of livestock production in East Asia” of November 2006) was discussed. It was concluded that this scheme (see below) is only appropriate for very large farms (> 100.000 pigs production) and activities.

Decision making procedure



For smaller farms (< 100.000 pigs production) usually not the whole procedure is required, and especially the Department of Agriculture (DA) and Environmental Protection Bureau (EPB) at count level are the most important decision makers in the process, and therefore DA and EPB are the most relevant organization for implementation of the spatial DST.



2. The required type of products of the spatial DST and the potential users of these products were discussed and identified. The products that were identified are (1) printed maps at county level, (2) printed maps at provincial/city level, and (3) the spatial DST itself. Based on these products the users of these products were identified, and are listed below. The table also includes a column with specific actions that are needed, e.g. training. The main users of the spatial DST that were identified are AD, EPB, and the State land resources bureau. However, given the limited number of participants in the workshop not all of the required information could be retrieved or verified.

The provincial organization has very limited GIS expertise; most GIS expertise is present at the universities and some special bureaus, e.g. statistics departments. GIS is currently being used at the Center of Epidemic Control of Guangdong Province for monitoring disease spread, and at EPB more often e.g. for analyzing water supply and distribution. The Station of Environmental Protection in the Department of Agriculture is mainly in administrative issues and not using GIS.

Users	Products			What is needed?
	Printed maps at county level	Printed maps at provincial / city level	GIS-Application (DST)	
Agricultural Bureau (county and city)	X (county)	X (city)		
Agricultural Department (province)		X	X	Training, equipment, software, etc. (there is currently no GIS capacity)
Environment Protection Bureau (county and city)	X (county)	X (city)		
Environment Protection Bureau (province)		X	X	?
Development Planning Bureau (province)			?	
City Planning Bureau			?	
State land resources bureau			X	

3. The purposes to involve ministries, departments and other stakeholders were identified as (1) data provision, (2) setting policy objectives, (3) setting technical criteria and (4) providing training. Who should be involved for these purposes was then discussed and the results are presented in the table below. DA, EPB, State Land Resource Bureau, Meteorological Bureau and Statistics Department were identified as important data holders, but the participants were not able to specify which type of data is available at these bureaus and departments. The results also include an extensive list of ministries, departments, NGOs and other to be invited in the policy objective and/or technical workshops of the project.

Stakeholders/institutions	Purpose			
	Data provision	Policy objectives setting	Technical criteria setting	Training
Department of Agriculture (Province), including Veterinary division and Water division	X	X	X	X
Environment Protection Bureau (Province)	X	X	X	
Rural Policy Research Center (Province)		X		
Development Planning Bureau – Rural division		X		
Department of Finance – Rural division		X		
Department of Finance – Rural development office		X		
Department of Science and Technology – Rural division		X		
South China Agricultural University			X	X
Agricultural College of Zhongkai			X	X
Technology College of Foshan			X	X
Department of Health			X	
Supervision Department of Export and Import		X		
Department of Economics and Trade		X		
Department of Business Administration		X		
Poultry Association			X	
Pig Producer Association			X	
Feed Association			X	
Dairy farming Association			X	
Fertilizer Association			X	
Department of Fisheries		X		
Academy of Agricultural Science		X	X	X
State land resources bureau	X (maps – both paper and digital)	X		
Meteorological Bureau	X			
Statistics Department	X (tables)			

Finally, a questionnaire was discussed among the participants of the workshop. The results of the questionnaire are listed below. The participants stated that in general they were very happy with the workshop and the provision of information in advance to the workshop. Some recommendations were made with respect to the development of the spatial DST.

	Yes	Relatively	No
1. Were you informed about the workshop sufficiently in advance?	x		
2. Was the purpose of the workshop clear to you before the event?	x		
3. Has the purpose of developing a spatial Decision Support Tool (DST) become clear to you during the workshop?	x		

4. Do you find the DST useful and relevant for the problems related to livestock development in your country?	x		
5. Did you find the workshop useful for expressing your views?		x	
6. Do you feel that you could voice your opinion?	x	x	
7. Does the output of the workshop reflect the views and ideas of everyone?		x	
8. Do you think the workshop clearly identified the issues in your field of expertise that should be included in the DST?		x	
9. Do you have any other comments or ideas for the further development of a spatial DST or the LWMEA project in general? <ul style="list-style-type: none"> • Practical tool that is useful • From macro point of view a very good assessment tool, which can better guide our work (macro = provincial level) • The DST might contribute more if it is able to provide detailed maps at county level; able to support farm location 			

4.2. Technical consultation meetings

The technical meeting aimed to further discuss the technical issues with respect to the spatial DST, especially the technical development of the spatial DST (regional activity), the development of a database management system (DBMS) (country-specific activity) and providing training in the use of the spatial DST (country-specific activity). One meeting took place, with an expert of EPB.

Meeting with representative Environmental Protection Bureau (EPB) – Environmental Monitoring Center (EMC), 24 April 2007

Present in this meeting were:

- Mr Wutao Zeng (EPB-EMC)
- Mr Gerrit Carsjens (Wageningen University)

The results and conclusions of the meeting were:

- EPB is using ArcGIS but AD is not.
- SEPA – National Environmental Monitoring Center provides data for specific projects and also licenses in ArcGIS for use in these projects only.
- Required expertise and capacity (hardware, software) is available at the Environmental Monitoring Center (EMC) and at universities, e.g. South China Agricultural University. Therefore AD and/or EPB might cooperate with the EMC or a university in order to get the required data, hardware and software. A letter of agreement might be option here. After the mission Prof. Hu Yueming of South China Agricultural University was contacted about the project, and he expressed a profound interest in the project.
- For the development of a DBMS the EMC or a university should be contacted.
- Training can be provided by universities.
- Some contacts should be established with relevant groups at universities to get more information and discuss their potential contribution in the project in more detail.

5. Conclusion and recommendations

5.1. Conclusion in relation to the mission results

Despite the considerable differences in the number of participants and type of organizations present during the workshops as well as the technical consultation meetings, some substantial progress has been made with the delineation of the preparation of a spatial DST. In all three countries, the context (goal and objectives) of the DST has been discussed, the types of products and its users identified, and the purposes to involve what (type of) stakeholders during the preparation and implementation phase have been browsed. Despite some (minor) differences among the participating countries, some general conclusions are:

1. All three countries stressed the need for a tool capable to be used at macro as well as micro level. At macro level the tool should be able to support the more strategic scanning of the different options for spatial development of livestock production at regional scale. The indicative scale at macro level: 1:100.000 to 1:500.000. At micro level the tool should be able to support more detailed decision making of allocation of livestock farms. Indicative scale at the local level: 1:50.000. The prospects to use the tool at the local level will, of course, depend highly of the availability and quality of data, especially the required geo-data. Nonetheless, the use of the spatial DST at two different scale levels is an important issue to be taken into account during the construction phase of the spatial DST and the (geo-)database.
2. There are large differences among the three countries with respect to the available (geo-)data. Although the construction of a (geo-)database and, if applicable, a DBMS (Data Base Management System) is a country-specific task, in each country the spatial DST should be able to communicate with these databases and DBMS. Therefore, the requirements for communication and data formats need to be identified.
3. In each of the countries some organizations have been identified that might be able to provide the required national expertise for the development of a (spatial) database and the implementation and training with respect to the DST. In case the contractors are not associated with the organizations that hold the end-users of the spatial DST, a tight communication and cooperation framework needs to be established between both.
4. The preparation of the spatial DST in ArcGIS is a regional activity. During the technical consultation meetings it became clear only few organizations in the participating countries have expertise in ArcGIS programming, with exception of the Asian Institute of Technology (AIT) in Bangkok, Thailand. This international institute holds a group of experienced programmers, who are also able to communicate in English. This is important since they need to cooperate closely with an international contractor who will coordinate the spatial DST development. Another argument in favor of this institute are their relative low fees for programmers (approx. 600 US\$ per month), especially compared to the fees of programmers from e.g. western countries.

5.2. Recommendations for the development of a spatial DST

The development of this (and any) DST will basically follow the next nine phases:

1. *Domain analysis or conceptual modeling*

Usually the developers of a DST are not an expert in the subject area, so the first task is to investigate the so-called domain or usage context of the software. Another objective of this work is to make the analysts who will later try to elicit and gather the requirements

from the area experts or professionals, speak with them in the domain's own terminology and to better understand what is being said by these people. Otherwise they will not be taken seriously. So, this phase is an important prelude to extracting and gathering the requirements. In general, this first phase has already become quite clear from the Area-Wide Integration (AWI) projects of FAO-LEAD, the LWMEA project preparation phase, and the result of the April 2007 mission. The basic context, concept and requirements of the spatial DST have been published before in the several project documents (see also Section 1.1 of this report) and related international scientific publications.

2. *Software elements analysis*

The most important task in creating a software product is extracting the requirements. The end-users typically know what they want, but not what software should do, while incomplete, ambiguous or contradictory requirements are recognized by skilled and experienced software engineers. Frequently demonstrating live code may help reduce the risk that the requirements are incorrect. These requirements have been (partially) identified during the country specific workshops, but need to be further elaborated upon during the development process and testing phase.

The phases 1 and 2, developing the conceptual model and identifying the requirements of the DST, have basically been dealt with in the Area-Wide Integration (AWI) projects of FAO-LEAD, the LWMEA project preparation phase, and the April 2007 mission. The basic concepts and requirements, as well as the general components of the spatial DST have been previously published in the several project documents (see Section 1.1 of this report) and related international scientific publications. Therefore, the next step will be:

3. *Specification*

Specification is the task of precisely describing the software to be written, possibly in a rigorous way. This phase includes, for example, the development of data flow diagrams or flow charts, workflow diagrams, and detailed component diagrams, required for the programming of the source code. During this phase also the needs and requirements of the (geo-)database needs to be specified. This phase should be carried out by the international contractor and expert in spatial planning and spatial decision support tools (code: IC-SP), who will also need to coordinate the further development and implementation of the spatial DST.

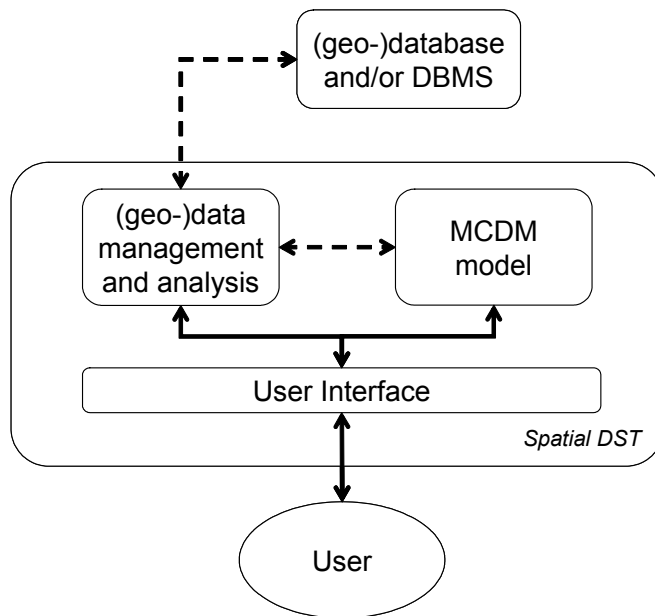
4. *Software architecture*

The architecture of a software system refers to an abstract representation of that system. Architecture is concerned with making sure the software system will meet the requirements of the product, as well as ensuring that future requirements can be addressed. The architecture step also addresses interfaces between the software system and other software products (such as present Data Base Management Systems or DBMS), as well as the underlying hardware or the host operating system. This phase should be carried out by the IC-SP and the international contractor responsible for the software coding (code: IC-SC). During this phase, the IC-SC and IC-SP will also need to communicate with the national contractor for spatial planning and spatial decision support tools; Code: NC-SP) who is responsible for coordinating the country-specific testing, documentation and training (see phases below) and the national contractors for (geo-)database development (code: NC-DB). The collection of geo-data and development of the country-specific (geo-)databases will also start in this phase. The IC-SC and IC-SP need to communicate regularly with the NC-DB on their progress.

5. *Implementation or actual software coding*

Reducing a design to code may be the most obvious part of the software engineering job, but it is not necessarily the largest portion. If the specifications and software architecture are clear, the actual coding by the IC-SC is a relatively smooth job.

However, not all components of the DST should be developed simultaneously, but preferably in separated modules. The general modules of the spatial DST are shown below (during the phase of specification these should be further detailed in more specific modules).



The development of the actual source code should start with the MCDM model, the heart of the spatial DST. Afterwards, the user interface and geo-data management and analysis tool will be developed. Finally some supplementary products are developed, such as a glossary, help functions and language modules (first in English, later-on in the process in Chinese, Thai and Vietnamese). In-between these steps the phase of testing will commence (see below).

6. *Testing*

Testing of (parts of) the spatial DST aims to identify the strengths and weaknesses (and errors) of the software, but is also especially useful to have the end-users reflect upon the software and assess required additions and other changes to make the DST better fit to the context or planning process it is being developed for. The testing of the software will be carried out by the NC-SP and end-users, coordinated by the IC-SP and IC-SC.

7. *Documentation*

An important (and often overlooked) task is documenting the internal design of software for the purpose of future maintenance and enhancement. Documentation is most important for external interfaces. This task should be carried out by the IC-SC and IC-SP and afterwards translated under the responsibility of the NC-SP.

8. *DST training and support*

A large percentage of software projects fail because the developers fail to realize that it doesn't matter how much time and planning a development team puts into creating software if nobody in an organization ends up using it. People are occasionally resistant to

change and avoid venturing into an unfamiliar area so, as a part of the deployment phase, it is very important to have training classes for the most enthusiastic software users (build excitement and confidence), shifting the training towards the neutral users intermixed with the avid supporters, and finally incorporate the rest of the organization into adopting the new software. Users will have lots of questions and software problems which leads to the next phase of software maintenance.

9. *Maintenance*

Maintaining and enhancing the DST to cope with new discovered problems or new requirements can take far more time than the initial development of the software. Not only may it be necessary to add code that does not fit the original design but just determining how software works at some point after it is completed may require significant effort by a software engineer. In general, about $\frac{2}{3}$ of all software engineering work is maintenance, although only a small part of that is fixing bugs. Most maintenance is about extending systems to do new things, which in many ways can be considered new work that falls out of the scope of the LWMEA project. However, for the implementation and a successful future use of the spatial DST it is of utmost importance to identify the needs and secure the means for future maintenance, especially given the fact that the development of the spatial DST is a regional and not a national task and responsibility.

Appendices

- A1. Mission schedule*
- A2. Agenda for the workshops*
- A3. Powerpoint presentation used for the introduction to the program and the spatial DST context*
- A4. Powerpoint presentation used for the description of the spatial DST framework*

A1. Mission schedule

Agenda of Gerrit Carsjens and Pierre Gerber related to spatial DST development

Vietnam				
			<i>Gerrit Carsjens (GC)</i>	<i>Pierre Gerber (PG)</i>
Date	Day			
12-04-07	Thursday	Morning		
		Afternoon	Meeting with PG	Meeting with GC
13-04-07	Friday	Morning	Spatial DST Workshop	
		Afternoon		
14-04-07	Saturday	Morning	Consultation with Hanoi Agricultural University	
		Afternoon	Reporting and meeting with Colin Burton & Harald Menzi	
15-04-07	Sunday	Morning	Meeting with FAO and World Bank	
		Afternoon		
16-04-07	Monday	Morning	Consultation with MONRE-DISC	
		Afternoon	Travel to Bangkok	
Thailand				
17-04-07	Tuesday	Morning	Preparation DST workshop, Reporting at FAO office	
		Afternoon		
18-04-07	Wednesday	Morning	Spatial DST Workshop	
		Afternoon		
19-04-07	Thursday	Morning	Consultation with GISTDA	
		Afternoon	Reporting	
20-04-07	Friday	Morning	Consultation with AIT	
		Afternoon	Travel to Guangzhou	
China – Guangdong Province				
21-04-07	Saturday	Morning	Reporting; RCG meeting; internal consultations	
		Afternoon		
22-04-07	Sunday	Morning	Reporting	Field visit
		Afternoon		
23-04-07	Monday	Morning	Spatial DST Workshop	
		Afternoon		
24-04-07	Tuesday	Morning	Consultation with EPB-EMC	
		Afternoon		

A2. Agenda for the workshops

LWMEA project April Mission Spatial DST Workshop

Language: English

Program

Objective of the Workshop

The overall objective of the spatial Decision Support Tool (DST) workshop is to review and discuss the country specific policy and decision making context and needs for spatial planning of future livestock production, to identify the requirements of a supporting tool and its basic components, and to discuss the practical arrangements to be made for developing the tool (operational users, target groups, technical capacity, data requirement and data supply, etc.).

Invited participants

This workshop is especially relevant for policy and decision makers at national and provincial level from the agricultural, environment and land use planning sectors, representatives of relevant stakeholder groups (farmers associations, environmentalists, and others), as well as technical experts in land use planning and GIS.

Expected results

The DST workshop will especially focus at the policy and decision making context and related issues. This workshop is especially interesting for policy and decision makers at national and provincial level of the departments of agriculture, environment and spatial and urban planning, and representatives of relevant stakeholder groups. The workshop should result in:

1. the identification of the (country specific) objectives and needs of the spatial DST,
2. the policy and decision making context and issues (relevant laws, regulations, incentives, etc.),
3. the intended output of the tool at national, provincial or other levels,
4. the operational users of the tool (what department, what people) and
5. a specification of the decision making procedure in which the tool should be used.

The National Steering Committee will have a specific role to stimulate and support the inter-ministerial and inter-departmental cooperation that will be required, e.g. to share data and information.

AGENDA Spatial DST Workshop

8.30 – 8.40	Welcome and review of the program of today
8.40 – 9.00	Brief introduction of each participant and his or her expectations for today
9.00 – 9.00	General introduction to the Livestock Waste Management in East Asia (LWMEA) project
9.30 – 10.15	General introduction to the spatial DST <ul style="list-style-type: none">• Livestock development and spatial issues• Objectives of the spatial DST• Approach in the AWI pilot projects – workshops and GIS analysis• Components of the spatial DST <i>Questions and discussion</i>
10.15 – 10.30	Coffee break
10.30 – 11.15	Hands-on demonstration – Applying GIS in the spatial DST <ul style="list-style-type: none">• Context of the Thai AWI project• Workshops – results• Examples of the steps in the GIS analysis <i>Questions and discussion</i>
11.15 – 12.15	Participants key concerns, problems or issues with respect to the spatial planning and allocation of livestock production areas that should be addressed with the spatial DST. Discussion and identification of the country specific goal and need for a spatial DST (at national and provincial level);
12.15 – 13.15	Lunch break
13.30 – 16.30	Plenary discussion: <ul style="list-style-type: none">• country specific policy and decision making context and procedure• operational users: background and needs• DST preparation approach: data, equipment and analysis• relevant ministries, departments and other stakeholders to be involved in the DST preparation process (with in-between coffee break)
16.30 – 17.00	Evaluation and further steps of the project
17.00	Closure

A3. Powerpoint presentation used for the introduction to the program and the spatial DST context

LWMEA
Spatial decision support tool (DST)

Gerrit J. Carsjens
Wageningen University, The Netherlands

Contents

1. Problem description and objectives
2. Spatial DST – approach
3. Spatial DST – components
4. Conclusions and today's issues

1. Problem description and objectives

Problem description

- Rapid growth of livestock production
- Especially large-scale industrial production
- The majority of (new) livestock farms is concentrated around major urban centers
- Result: environmental, public and animal health concerns

1. Problem description and objectives

1. Problem description and objectives

Distance to Bangkok (km)	Human pop (p/km ² /10)	pigs (nb/km ²)	chicken (nb/km ² /10)	maize (tons/km ²)	soybean (10 ³ tons/km ²)	cassava (tons/km ² /2)
50	130	10	10	10	10	10
100	140	80	100	10	10	10
150	100	40	60	10	10	10
200	60	20	30	10	10	10
250	30	10	15	10	10	10
300	15	5	8	10	10	10
350	10	5	5	10	10	10
400	8	5	5	10	10	10
450	7	5	5	10	10	10
500	6	5	5	10	10	10

1. Problem description and objectives

1. Problem description and objectives

Overall objective

Develop a spatial decision support tool (DST) to support a more sustainable spatial planning and distribution of livestock production areas

Therefore the spatial DST should be able to:

- Prevent environmental impacts from future livestock production
- Identify suitable and unsuitable areas for livestock production
- Prevent negative environmental impacts by a proper zoning and buffering of sensitive areas

1. Problem description and objectives

Macro level:

Distribution of livestock production at national/provincial level.

Objective: prevent pollution from livestock production by maintaining land-livestock balance

Nutrient overload Nutrient deficiency

1. Problem description and objectives

Micro level:

Distribution of livestock production at local (county, district) level.

Objective: prevent pollution of local concern (smell, disease risk) by maintaining safe distances from sensitive areas

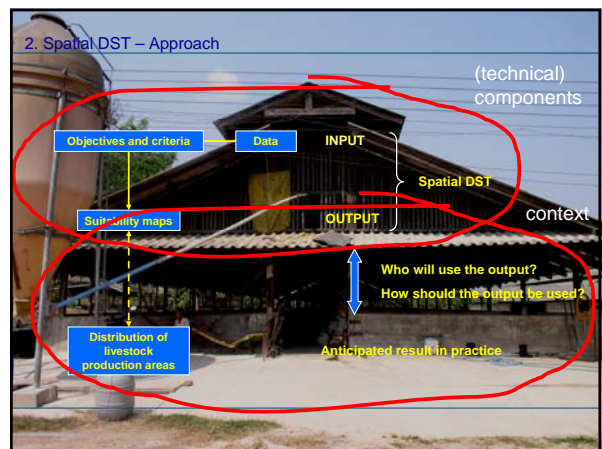
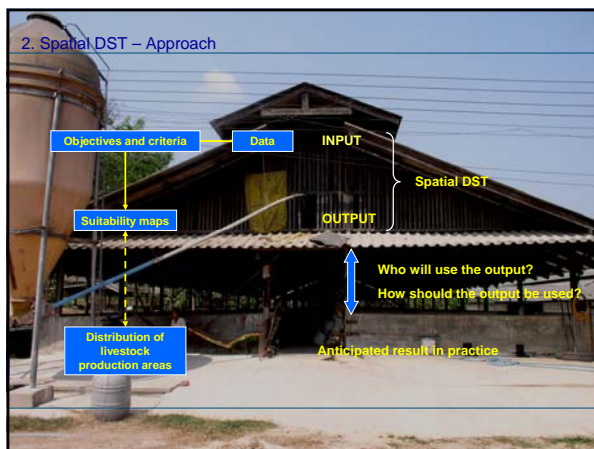
Suitability map

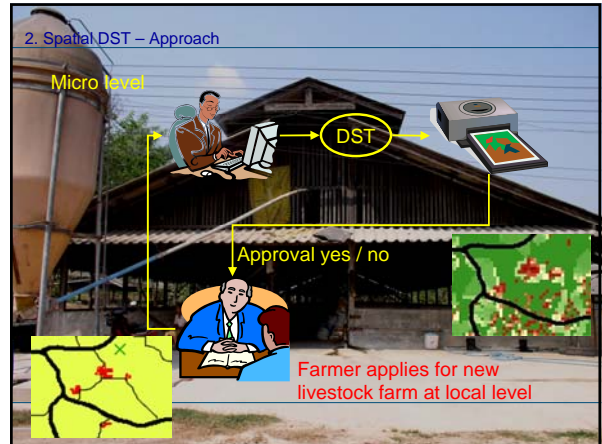
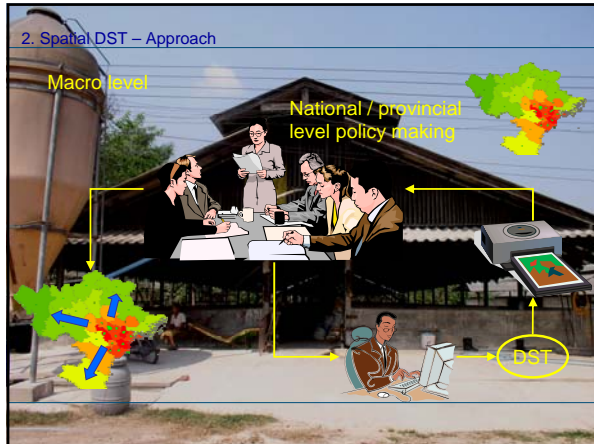
Avoid sensitive locations, e.g. close to towns or nature reserves (in red)

Promote new farms established at more suitable locations (in green)

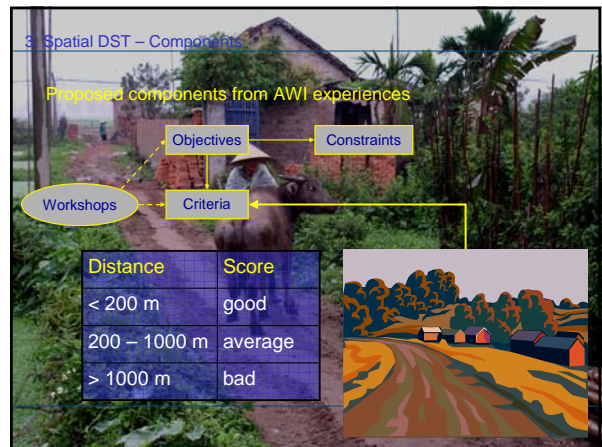
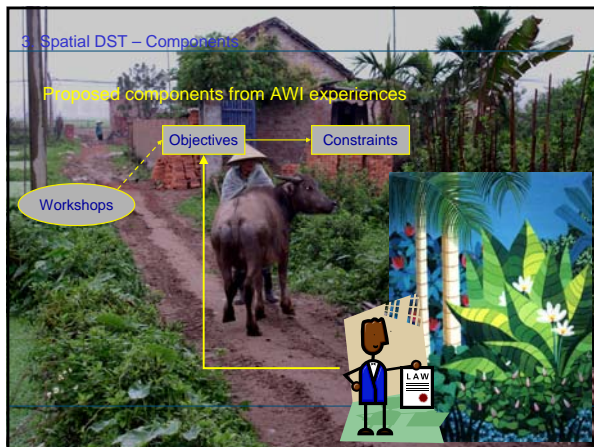
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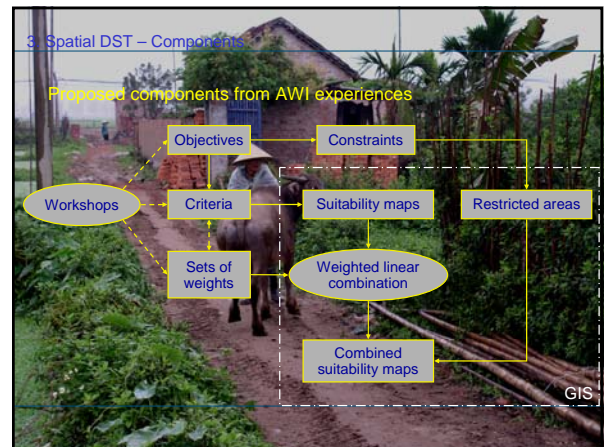
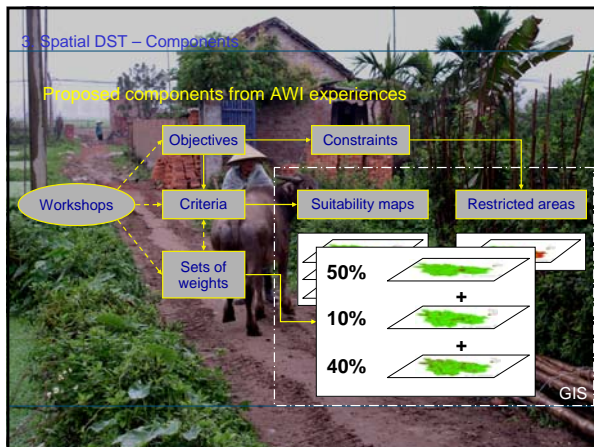
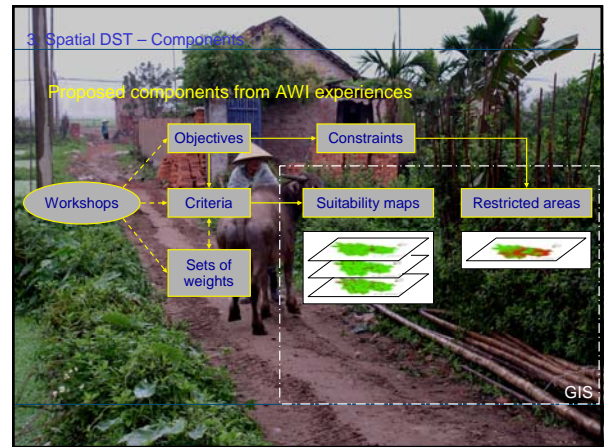
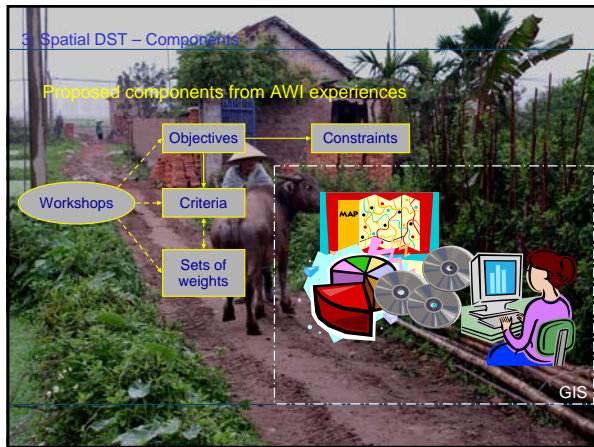
1. Problem description and objectives
2. Spatial DST – approach
3. Spatial DST – components
4. Conclusions and today's issues

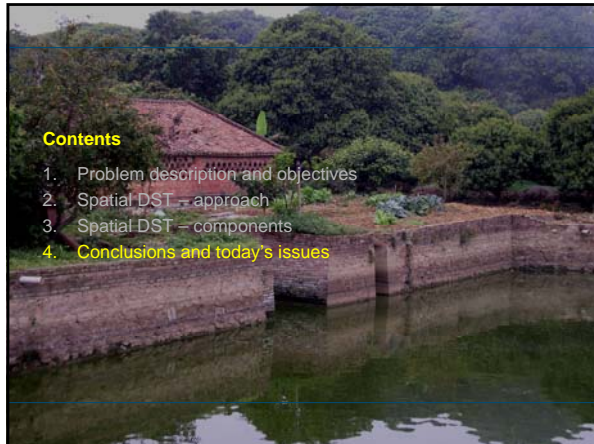




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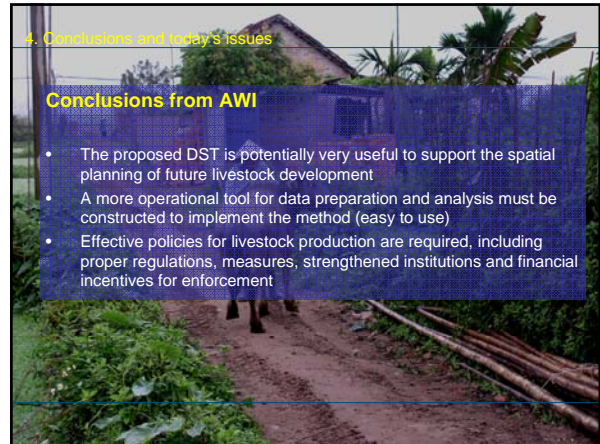






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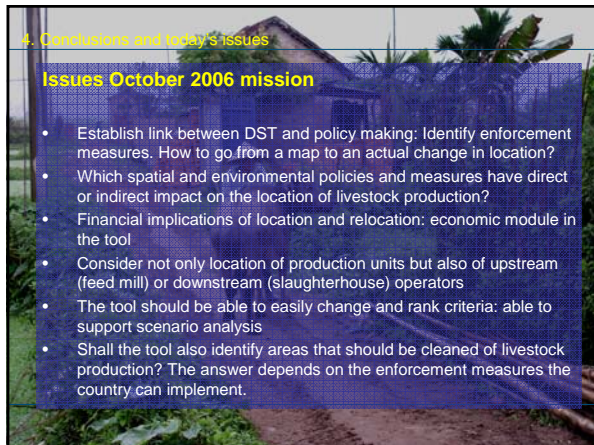
1. Problem description and objectives
2. Spatial DST – approach
3. Spatial DST – components
4. **Conclusions and today's issues**



4. Conclusions and today's issues

Conclusions from AWI

- The proposed DST is potentially very useful to support the spatial planning of future livestock development
- A more operational tool for data preparation and analysis must be constructed to implement the method (easy to use)
- Effective policies for livestock production are required, including proper regulations, measures, strengthened institutions and financial incentives for enforcement



4. Conclusions and today's issues

Issues October 2006 mission

- Establish link between DST and policy making: Identify enforcement measures. How to go from a map to an actual change in location?
- Which spatial and environmental policies and measures have direct or indirect impact on the location of livestock production?
- Financial implications of location and relocation: economic module in the tool
- Consider not only location of production units but also of upstream (feed mill) or downstream (slaughterhouse) operators
- The tool should be able to easily change and rank criteria: able to support scenario analysis
- Shall the tool also identify areas that should be cleaned of livestock production? The answer depends on the enforcement measures the country can implement.



4. Conclusions and today's issues

Key questions for today's workshop

- | | |
|---------------|--|
| 11.15 – 12.15 | What are the country specific needs and requirements for a spatial DST? Is this what you need? |
| 13.15 – 14.15 | How should the decision making process (in which the DST is to be used) look like, and who should be involved? |
| 14.15 – 15.15 | How should the tool be prepared given the present resources and capacity? |
| 15.15 – 17.15 | How might the livestock sector develop in the next decade, and how to deal with that? |
- What are relevant laws, regulations and incentives with respect to these developments?
What are relevant objectives for the DST?

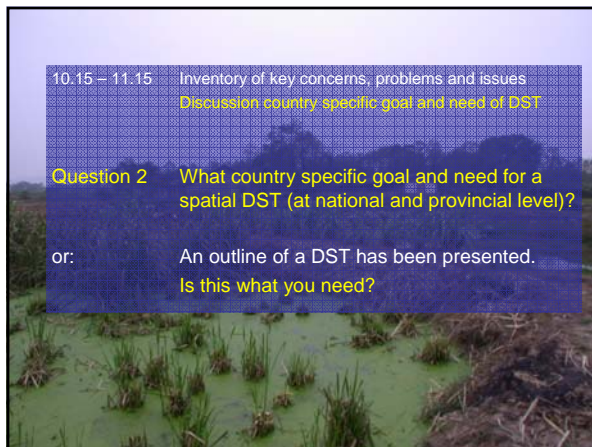
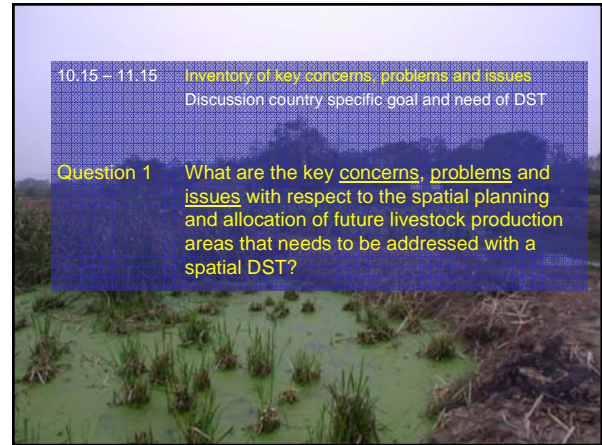
A4. Powerpoint presentation used for the description of the spatial DST framework

LWMEA Workshop Spatial DST - Program

Hanoi
13 April 2007

Program

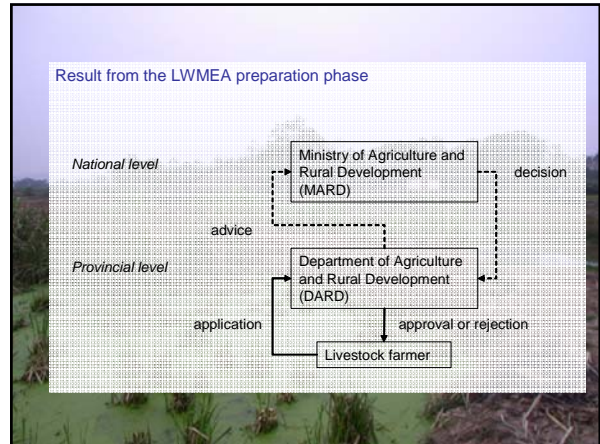
08.30 – 08.40	Introduction
08.40 – 09.00	Participant introduction and expectations
09.00 – 10.00	General introduction spatial DST
10.00 – 10.15	Coffee break
10.15 – 11.15	Country specific goal and need of DST
11.15 – 12.15	Demonstration components DST from AWI
12.15 – 13.15	Lunch break
13.15 – 14.15	Context, operational users and relevant stakeholders
14.15 – 15.15	Preparing the DST given the resources and capacity
15.15 – 17.15	Working group sessions
17.15 – 17.30	Conclusions
17.30	Closing



Discussion country specific policy and decision making context, operational users, relevant ministries, departments and other Stakeholders to be involved in the process

Assignment Discuss and draw a scheme of a decision making procedure that shows how the DST is being used.

Questions Who are users of the DST and its output?
 What products?
 What ministries, departments, stakeholders should be involved?



14.30 – 16.00 Working group sessions

Objective Identify and discuss objectives and decision making context in thematic working groups:

- relevant laws, regulation, incentives?
- objectives to be included in DST?
- importance (weights) of these objectives?

Question Which thematic working groups?

For instance: (1) environmental protection, (2) rural development and poverty issues, (3) public and animal health issues, (4) economic profitability

