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BỘ MÔN ĐO ẢNH VÀ VIỄN THÁM

BÁO CÁO HỌC THUẬT

IDENTIFYING DRIVERS OF LAND USE/LAND COVER CHANGES AND THEIR IMPACTS USING DELPHI METHOD

(Xác định nguyên nhân thay đổi thực phủ/sử dụng đất và tác động của nó sử dụng phương pháp Delphi)

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CONTENTS

1. LAND COVER AND LAND USE CHANGES

1.1. Definition of land cover/land use changes

- Land cover is defined as the biophysical attributes of the Earth surface and the immediate subsurface. Land cover varies in space and time. Land cover changes can be categorized into land cover conversions and modifications (Lambin et al 2003). Land cover conversions are the complete replacement of one cover type by another, whereas land cover modifications include subtle changes that affect the character of the land cover without changing its overall classification. Alternatively, land use has been defined as the purposes for which humans exploit the land cover. It refers to the manipulation of these attributes by humans to meet different needs, for instance, agriculture, husbandry, etc (Lambin et al. 2003). Land use change (LUC) is a change in the use or management of land by humans.
- Therefore, land use affects land cover, and the attendant land cover changes affect land use (Giri 2012). Land cover and land use are intimately linked, and the links define a human – environment or social – biophysical system in specific spatial and temporal contexts (Lambin et al. 2003). Research in human - environment interactions aiming at a better understanding of land use/cover changes (LUCC) processes has taken place across multiple disciplines, locations, and scales by many scientists.

1.2. Overview of the main drivers of land cover/land use change

- Different drivers are identified to lead to LUCC in multiple case studies. According to Lambin et al. (2003), there are five fundamental high-level causes of LUCC. First, resource scarcity leads to an increase in the pressure of production on resources, e.g. natural population growth, or decrease in land availability due to encroachment by other land uses. Second, changing opportunities are created by markets, e.g.

increase in commercialization and agro-industrialization, or changes in market prices of inputs or outputs. Third, there are external policy interventions, e.g. economic development programs or war. Fourth, loss of adaptive capacity and increased vulnerability of population might be drivers of LUCC, e.g. risks associated with natural hazards such as the ones leading to crop failure, loss of resource, or loss of productive capacity. Fifth, there are changes in social organization, in resource access, and in attitudes, e.g. lack of public education or growth of urban aspirations (Lambin et al. 2003).

- In the 20th century, many studies focused on the relations between LUCC and demographic growth. Since the start of the 21th century, a variety of human activities, socio-economic, and environmental factors including local decisions, rapid demographic changes, technological advances, biophysics, ecology, economic development, institutional and cultural factors have been considered as the major drivers of LUCC.

1.3. Overview of the main impacts of land cover/land use change

- The current rates and magnitudes of LUCC are unprecedented. The consequences, or impacts, of LUCC might be positive or negative on different components of the human-environment system. Previous research on LUCC has highlighted worrying impacts of LUCC on a variety of environmental and human life components and processes at local to global scales including impacts on global atmospheric circulation, biogeochemical cycles, global and local climate; desertification; soil degradation and erosion (leading to low productivity, food insecurity, and poverty); pollution of surface water and flooding risk increase; degradation of worldwide biotic diversity and capacity of biological systems; pollution through biomass burning and agro-chemicals (leading to health problems and acidification of

precipitation).

- Hence, several international agendas were introduced relating to LUCC issue. For example, the International Geosphere and Biosphere Programme (IGBP; over the period 1987 – 2015) focused on global environmental issues resulting from LUCC, defined and promoted by LUCC research. Currently, the United Nation Framework Convention on Climate Change (UNFCCC) (since 1992 until now), the Kyoto Protocol (the first period 2008 – 2012, the second period 2013 – 2020), and the Paris agreement (since October 2016) mention land cover changes and deforestation as important processes to be tackled to address the challenge of climate change. Several of the newly established Sustainable Development Goals of the United Nations (from 2015 to 2030) are related to the issue of LUCC, through their focus on biodiversity and ecosystems, forest, climate change, but also poverty reduction, health and well-being, availability of clean water and sanitation, and the development of sustainable cities and communities.

2. INTERVIEW

2.1. Advantages of method

- Exploratory phase
  - Fast access to new or unknown field
  - Quick way to obtain specific information
  - Less time consuming than many other methods
- Experts
  - Have high insight in aggregated and/or specific knowledge
    - Processes, Group Behaviors, Strategies, etc.
    - Information difficult to explore by other methods
  - Often networked person
    - Easily leads to other interviews
  - Motivated persons
    - Often willing to cooperate and exchange
    - Problems of influencing less problematic

2.2. Methodological defense

- Argue for differentiation of expert interview types
  - Explorative expert interviews: Technical knowledge
  - Systematizing expert interviews: Process knowledge
  - Theory generating expert interviews: Explanatory knowledge
- Argue for differentiation of 6 interaction types
  - Interviewer as co-expert
  - Interviewer as expert outside of field
  - Interviewer as lay person
  - Interviewer as authority
  - Interviewer as confederate
  - Interviewer as possible critic
- Argue in favor of interpreting interaction effects as part of data

production

a - Explorative expert interview

- When used
  - Used as first orientation in new fields
  - Better structuring of a problem
  - Used for preparing interview topic lists or surveys
- Interview preparation and practice
  - Can be very open and unstructured
  - Structure interviews on basis of basic topic list
  - No emphasis on comparability or aggregation of information
  - Topic lists can vary according to expertise interviewee

*** Example**

- Internet filtering
  - Questions asked in this phase
    - What are the main themes of the debate?
    - What are the main problems?
    - Who are the main players?

b - Systematizing expert interview

- When used?
  - Focus on exclusivity of expert knowledge
    - When person has gained expertise in praxis
    - Based on expertise or exclusive position
  - Used for information which otherwise not accessible
  - Focus on comparability and aggregation
- Interview preparation and practice
  - Focus on systematic and full disclosure of information
  - Open more detailed topic list
    - However, allow for interviewee to answer extensively
  - Different interviews follow same trajectory to be able to compare

and aggregate data.

*** Example**

- Asia plus indicators
  - To what extend can survey methods used by the Asian be used in the accession countries?
  - No knowledge available on very specific topic.
  - Interview with various research/survey companies/institutions in these countries.
- Interview Questions
  - How does carrying out surveys in accession countries differ from the rest of Asia?
  - What difficulties do you encounter when carrying out surveys?
  - How do you collect addresses and how do you select respondents?

c - Theory generating interview

- When used
  - Interviewee more than information source
  - Focus on subjective aspects of expert's knowledge
  - Focus on motives, routines, implicit beliefs impacting on functioning of experts and systems
- Interview preparation and practice
  - Questions focus on motives, beliefs, routines of experts
  - Often related to the function of experts less on knowledge
  - Open questions
    - but often part of systematizing interviews
  - Different interviews follow same trajectory to be able to compare and aggregate data.

*** Example**

- Epistemic groups in telecom reform

  - 80s-90s Telecom reform in North and South
  - In South supported by consultants from North
  - Background and experience in the North has impact on how they conceptualize problems.
- Interview questions
  - What are the general problems of telecoms in the South?
  - Are market reforms as carried out in the North a possible solution for the South?

d – Framework

- ***Description on the basis of 7 characteristics***
  - Dimension of typology
  - Communication during interview
  - Status of interviewer
  - Style of questioning
  - Advantages
  - Disadvantages
  - When used?

e - Interviewer as co-expert

- Dimension of typology
  - Knowledge level comparable
- Communication during interview
  - Symmetric, high level of interaction, many questions by expert
- Status of interviewer
  - Knowledge of terminology and field
- Style of questioning
  - Dialog, permanent questions, in depth questioning, intervening
- Advantages
  - High level of discussion and information generation
- Disadvantages

  - Remains within framework of field, technical details
- When used?
  - Explorative or systematizing
  - Facts and data oriented questions

f - Interviewer expert outside field

- Dimension of typology
  - Knowledge level of equal standing
- Communication during interview
  - Symmetric, high level of interaction, many questions by expert
- Status of interviewer
  - Knowledge of terminology and less of field
- Style of questioning
  - Dialog, permanent questions, in depth questioning, intervening
- Advantages
  - High level of discussion and information generation
  - High explanation of motives and orientation
- Disadvantages
  - Remains within framework of field, technical details
- When used?
  - Explorative or systematizing, facts and data oriented questions

g - Interviewer as lay person

- Dimension of typology
  - Low level of knowledge of the field
- Communication during interview
  - Asymmetric in favor of interviewee ☐ monologue, paternalistic
- Status of interviewer
  - Low status of interviewer, low level of interest of interviewee
- Style of questioning

  - Broad questions which can generate longer answers
  - Naive subsequent questions
- Advantages
  - High level of confidence by interviewee ☐ pressure to explain
- Disadvantages
  - Interviewer cannot guide the interview
- When used?
  - Explorative interview, theory generating when focused on motives, norms

h - Interviewer as authority

- Dimension of typology
  - Evaluator, higher field knowledge
- Communication during interview
  - Asymmetric in favor of interviewer ☐ legitimation strategies by interviewee
- Status of interviewer
  - Institutional background, high expertise, power position
- Style of questioning
  - More authoritarian style of questioning
  - Frequent and critical subsequent questions
- Advantages
  - Expressive presentation of interviewee
- Disadvantages
  - Avoiding of certain topics, withholding information
- When used?
  - Not recommended but unavoidable when formally evaluating

i - Interviewer as confederate

- Dimension of typology

  - Same normative frame of thinking
- Communication during interview
  - Sharing of experiences, informal style of dialogue
- Status of interviewer
  - Personal relation, shared experiences
- Style of questioning
  - Informal style of questioning, Different types of questioning possible
- Advantages
  - High trust between partners
  - Access to confidential information ☐ Agree on how to treat this type of info
- Disadvantages
  - Normative framework and assumptions not questioned
- When used?
  - Explorative, systematizing and theory generating

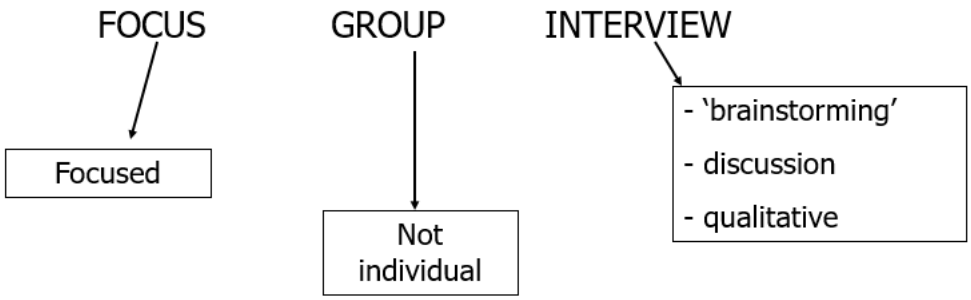
j - Interviewer as potential critic

- Dimension of typology
  - Different normative frame of thinking
- Communication during interview
  - Declining to answer, short answers, critical return questions
- Status of interviewer
  - Interviewers (or institutional) position known as ‘critic’
- Style of questioning
  - Critical and biased questioning
  - No verbal and non-verbal confirmation by interviewer
- Advantages
  - Detailed explication of normative stance and assumptions

- Disadvantages
  - Disruption of dialogue
- When used?
  - Not recommended, can be interesting in theory generating interviews

2.3. Focus group interviews

- ’30-’50: origin in marketing
- ’80: used by academics



“a group of individuals selected and assembled by researchers to discuss and comment on, from personal experience, the topic that is the subject of research”

*** Interaction process**

Main advantage of focus group interviews

- Not a cheap alternative to face-to-face (bias)
- Focus on group interaction effects
- ‘meaning-in-context’

6 stages group formation process:

- Globality: notice differences
- Differentiation: situate differences
- Social integration: group is being formed
- Mirroring: reassuring that people are ‘mirrors’ of yourself
- Condensation: coalitions are formed
- Information exchange: no longer strangers, open discussion

*** Uses of focus groups in research**

As a core research method to:

- Gain insight into participants' understandings and views of an issue
- Gain insight into how these views relate to each other (debates and arguments)
- Look at how such views are formed through group effects

Also useful for:

- Preliminary brainstorming: generating potential lines of enquiry
- Developing survey or interview questions
- Disseminating research findings and receiving feedback
- Raising consciousness

When we want to know:

- "the spectrum of views that individuals hold regarding a particular issue"
    - ☐ complement knowledge from quantitative studies
    - ☐ attitudes, opinions, motives, decisions, ideas, emotions, experience, appreciation, …
    - ☐ underlying explanations
    - ☐ introducing solutions ➔ expectations, needs, problems, … related to the intervention
- "the nature of their interaction and dialogue over that issue":
    - ☐ exploration for questionnaire, …
    - ☐ discourse/local vocabulary
    - ☐ argumentations

bottlenecks, problems,

*** Stages in conducting FGI's**

- Stage 1: select the research team

- Preferably 3 people with knowledge on the subject:
    - ☐ 1 moderator:

- interviewer
- facilitator
- leader (eye on the time!)
- psychologist

- 1 rapporteur: makes notes and observes
- 1 technician: takes care of dictaphone and other equipment; makes notes

- Training and pre-testing
- Moderator: 'native speaker'/part of the group

- Stage 2: select the participants

- 4 to 12 – anticipate on drop outs!
- Homogeneous group: people with comparable capacities/characteristics (social status/class, age, gender, …)
- People that have experience in common but are different at the same time
- 'Snowball sampling', 'gatekeepers', preliminary questionnaire, …
- Strangers or existing social group?

- Stage 3: set date and location

- Appropriate location:
  - Accessibility (public) transport
  - "natural setting"
  - noise
  - …
- Appropriate date and time (traffic jam, transport time)
- Spatial setting: meeting room
- Comfort/privacy
- Duration: 1 to 2 hours
- Food and drinks/break

- Stage 4: design your topic guide

- In advance
- Topics and issues to be dealt with in the FGI, some items
- Leave room for unprepared relevant issues
- General structure (~interviewing)
    - Opening question: who's who?
    - Introductory question
    - Transitional question
    - Key questions
    - Concluding questions
    - Summary

- Stage 5: FGI

- Interviewer
    - Monitor themes, topics, questions
    - Insisting
- Facilitator
    - Involve every participant in the conversation
    - Promoting cross conversations
- Psychologist/therapist
    - Improving the group relation
        - Participants that hinder the discussion
        - Participants that promote the discussion
        - Subgroups/power relations
        - Fights/conflicts
    - Non-verbal behavior
- Leader/time monitor

+ Active techniques:

- Brainstorming
- Rating
- Collective decision techniques (forced choice)

- Conceptual mapping
- Photo sorting

+ Projection techniques:

- Complete sentences
- Collages
- Drawings
- Comparison/analogy
- Fantasy/daydreaming

+ Group techniques:

- Designing a campaign
- Role play
- Team debate (subgrouping)

+ Phases:

- Welcome talk (+drop-off)
- Kick-off:
  - Goal
  - Presentation of participants (name cards?)
  - procedures
- Main part (+break?)
- Closing talk (summary?)
- After talk

+ Pitfalls in the discussion:

- Keep moderator's position
- Personal attacks/unrespectful remarks
- Incorrect/dangerous information
- Personal information

- Stage 6: record the conversation

- Double recording: dictaphone and notes
- Make sure you have good functioning equipment

- Make a sketch of the positioning of the participants
- Record in the language of the participants
- Pay attention to the recording of non-verbal behaviour
- Summarise after every interview

Limits of audio transcription ➔ complement textual records with emotional tonality, expressions, group dynamics, …

- Stage 7: analyse the data

- Immediately after every interview
- Identify trends and patterns
- Look for frequently occurring opinions and attitudes
- Analyse every question seperately
- Data triangulation!

2.4. How do you select and interview the experts?

a - How do you select an expert?

- Explorative and systematizing interviews
  - Different actors, points of views involved
  - Different aspects or fields impacting issues
  - Use interviews to snow ball selection
    - Ask for other experts and fields involved
    - Ask for experts with similar or deviant views
  - E.g. Business modeling
    - Interview different actors in value chain
  - E.g. Evaluation of FP 5
    - Interview project manager, financial officer, responsible for project, etc.
- Theory generating interviews
  - Interviewees in the same group
  - Sharing a common background or function
  - Makes generalizing about specific group possible

        - E.g telecom consultants as an epistemological group
- Do not necessarily go for the top shots
    - Sometimes have a good overview
    - BUT may lack expert knowledge on issues of interest
    - Are over committed and thus less time to commit
    - Experts on lower level might have much more detailed knowledge
- How to find them
    - Snowballing
    - Specialized literature review
    - Specialized conference reviews
    - Directly call companies (although mostly less successful)
    - Go through umbrella organizations

b - How do you approach?

- Are interviewees open to cooperate?
    - Not uniform answer, but mostly positive
- Way you take up contact influences willingness
    - Approach actors only after first study of the field
    - Letter, eMail or Phone:
        - Explain what the goals, content and function of the research is
        - Convince by knowledge ☐ detailed and well formulated mail
        - NOT: ‘can we meet to talk’, ‘hi, I’m a first year student’
        - Explain own affiliation, client, background
        - In case of no response, ask again (phone)
        - Clearly fix time span in advance e.g. 45 min - 1 hour

c - How do you interview?

- Preparation
  - Become a quasi-expert
  - Only start after sound preparation
  - The younger you are, the better you have to prepare
    - Risk of sliding into lay person interview
    - Paternalistic non-disclosing attitude
- Interview guide or topic list
  - How to construct depends on type of interview
  - Basic open interview guide (main questions)
  - But also prepare some interjecting questions
- Before starting the interview
  - Start with outlining goal and set up of research
  - Explain scope of the interview
  - Explain processing of information
    - Aggregation per type of actor or sector
    - No individual citation or individual citation, etc.
  - Explain how you will handle confidential information
    - Send written interview, text or text excerpts with citations
- To Record or Not to Record
  - Ask whether interviewee agrees with recording
  - Explain why you are recording
    - E.g. Only for own recollection, No direct citations, etc.
  - If interviewee not confident, don't record
    - Will otherwise impact on information gathering
- Interacting during interview
  - Not important to stay 'neutral' as in qualitative interviews
  - Share some of your own knowledge, thoughts, insights
    - Will keep interviewee interested and balances positions?
    - Methodologically not problematic

        - Expert is not easily influenced and is used to defend position
- Interaction depends on interaction type
    - As co-expert
        - Stimulate discussion, but leave enough room for open answers
        - Intervene when interviewee departs from subject
    - As critic
        - Intervene with more critical questions
    - Interview interaction types can be mixed
        - E.g. Start as co-expert and evolve towards critic
        - BUT never slip into conflicting positions
    - End with a ‘cut the crap’ section!!! STOP RECORDING!!!

d – How to use data?

- General remarks
    - Discourse and how views are expressed not important
    - What is thematically similar or different is important
        - Generalization, systematization
        - Explaining differences
- Transcription
    - Write out spoken text or paraphrase
        - No need to take into account non-verbal communication, pitch of voice, etc. (Not a narrative interview)
    - Transcribe only relevant parts
        - Leave sidetracks out
        - Transcription and summarization of less well-structured phrases
        - Respect the flow of text but identify different themes and thoughts in separate paragraphs

        - BUT represent the full meaning of interviews
- Labeling
    - Label each paragraph
        - Keywords, themes, issues, reformulated hypothesis
        - Multiple labels per paragraph
- Ordering
    - Sort paragraphs in separate document
    - According to themes
        - Clustering of themes and sub themes
    - According to actors
        - E.g value chain, different networks cable/telecom
    - Construction of table of contents
- Analyze at the level of themes
    - Write text looking for communalities, divergences, conflicting points of view
    - Which experts don't answer questions, don't hold opinions, etc.
    - Why?
- Analyze over the themes
    - Generating insights between the themes
    - Identify relations
    - Build typologies and generalizations
- Integrate with literature and theory
- Feedback
    - Important and often forgotten
    - Send email or letter to thank afterwards
    - Send report or synthesis at the end
        - State this before the interview
        - Creates a win-win situation
        - Makes it possible to go back ...

3. DELPHI METHOD

3.1. Method

- The Delphi method aims at reaching consensus among expert opinions on LUCC drivers and impacts. Linstone and Turoff (2002) described the Delphi approach as a technique of structuring the communication and discussion of a group of experts, in such a way that complex problems can be solved.
- Multiple experts may have different knowledge, experiences and opinions on the same issue (Chu and Hwang 2007). The KAMET (Knowledge Acquisition for Multiple Experts with Time scales) Delphi method (Chu and Hwang 2007) used in this study elicits the opinion of a variety of experts, in order to identify a consensus on the significant indicators of drivers and consequences of LUCC.
- The Delphi approach is an iterative knowledge expert survey, through which each individual expert is asked to re-evaluate his opinion after being confronted to the average evaluation of the expert panel. The exchange of opinions through this process, offers the advantage for participants to learn from each other and contribute to a final agreement. In this study, the expert Delphi method was applied in 2 survey rounds, using the same procedure at province and district scale (Figure 3.1).

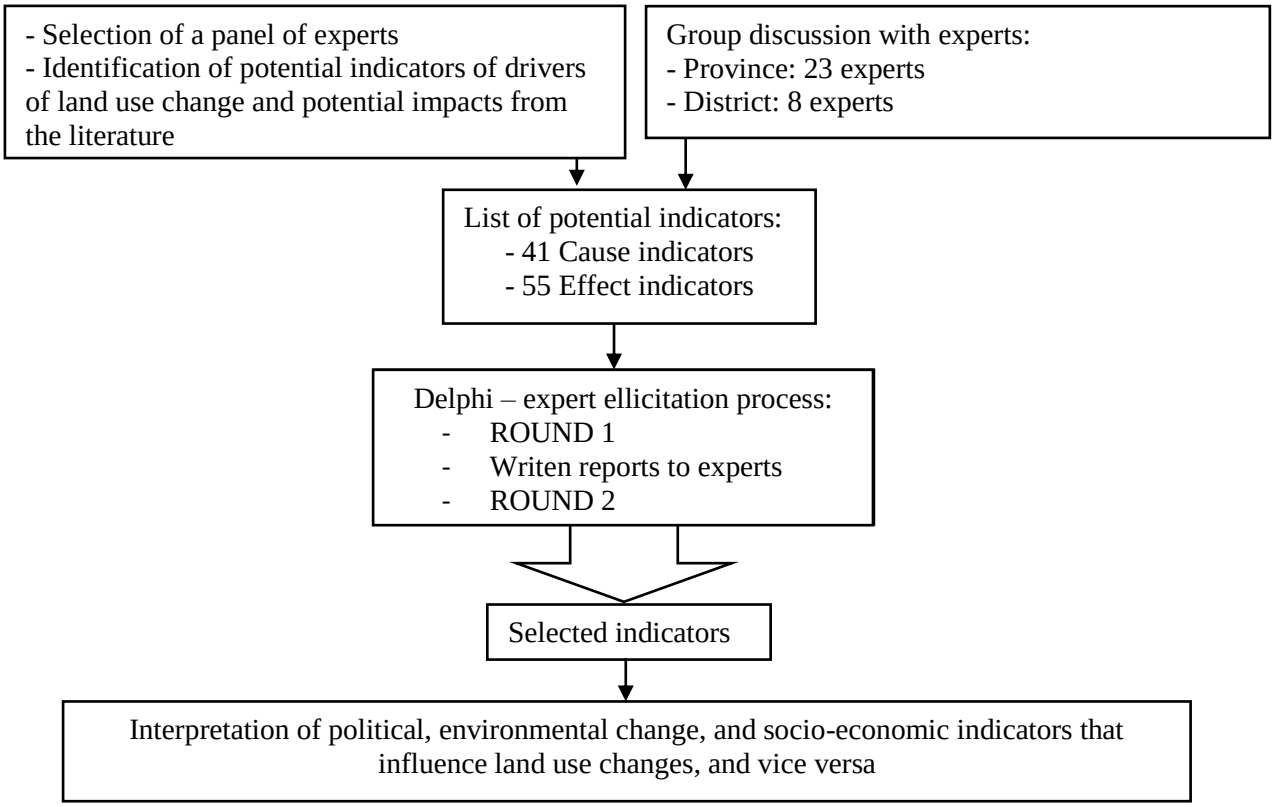


Figure 3.1 Research method: Delphi method on LUCC drivers and impacts

**** Expert panels and potential indicators:***

– A panel of 23 experts was established for the analysis at the provincial scale. It included managers from various provincial departments in Ca Mau (e.g. Natural Resources and Environment, Agriculture and Rural Development, the Hydrometeorology Institute, the Statistics Office, and the Forestry Department), and researchers who studied Ca Mau (i.e. from Can Tho university, Ho Chi Minh City University of Social Sciences and Humanities, Vietnamese Academy of Science and Technology). At district level, a separate panel of 8 experts included the managers of the district People's Committee, and district departments of agriculture, forestry, and statistics. The

average age of the experts is 51. Only one expert out of 31 was a woman.

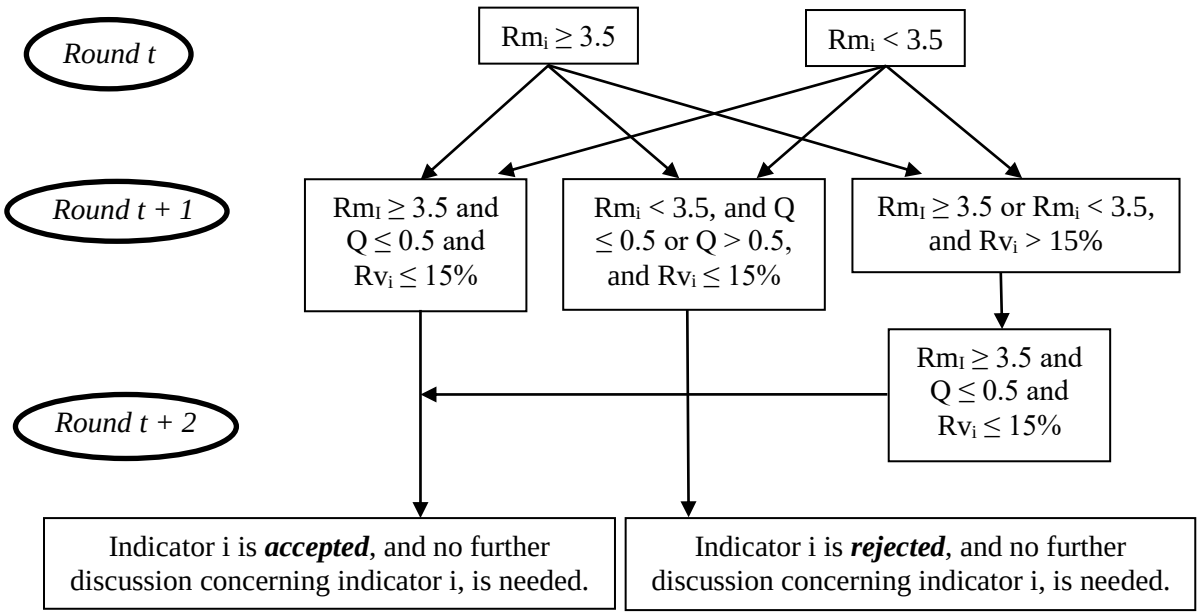
– A literature review prior to the expert meetings allowed establishing a provisional list of potential drivers and impacts of LUCC in the study area. A first discussion with the experts was organized in November and December 2013, in Ca Mau city and the Tran Van Thoi town, respectively. The results of the remote sensing LUCC study were presented, and the indicators were discussed with the experts to obtain a complete list of potential indicators (Appendix 1). Four groups of potential drivers indicators were identified including historic and political factors (4 indicators), socio-demographic factors (16); economic factors (5); and physical and environmental factors (16). Three groups of indicators were identified for potential impacts, i.e. socio-demographic impacts (14), economic impacts (29), and environmental impacts (12). A single list of potential indicators was built for the two analysed scales based on the integration of inputs form the two panels of experts at provincial and district levels.

* ***The two survey rounds:***

– After the first meeting, each individual expert was invited to independently evaluate the relevance of each indicator as driver or impact of LUCC on a five level scale (1 = not relevant; 5 = highly relevant indicator).

– The results of the first assessment round are described as the median, the mean, the quartile deviation and the variance of the experts' ratings for each indicator. These results were presented in a written report submitted to each participating expert. Each expert was then invited to re-evaluate its score for each indicator.

The expert could decide to keep his/her opinion, or they could change it taking into account the outcome of the first round. The Delphi method stops after two, three or more rounds once all of the potential indicators are accepted or rejected (Chu and Hwang 2007). The rules used to analyse the ratings by the experts and the criteria for accepting or rejecting an indicator are shown in Figure 3.2 (Chu and Hwang 2007). In our case, a consensus was reached after two rounds of assessment.



3.2 Results

3.2.1. Driver indicators

– Among the 41 potential driver indicators, 26 obtained a rating mean above 3.5 during the first round for the province. The 15 remaining indicators scored below 3.5. For the district, 30 and 11 scored above and below 3.5, respectively. In round 1, the indicators for which the disagreement among experts is the largest (high quartile deviation) include the dense network of

rivers and canals, the disease of plants, livestock, and poultry for the province, and geology and drought for the district.

- The distribution of ratings for selected and unselected driver indicators after round 2 are presented as box plots in Appendix 2 for the province and the district.
- All indicators with a high rating were confirmed as relevant by experts in round 2. In addition, three more cause indicators (topography, population/population growth, and forest fire) for the province, and two more cause indicators for the district (drought and agriculture yield) were selected as relevant in round 2. In total 29 and 32 indicators were considered relevant (significant drivers of LUCC) for the Ca Mau Province and the Tran Van Thoi District, respectively. The experts selected 27 similar indicators for the two analysis scales. These include the four historic-political factors as well as some of the socio-demographic, economic and environmental factors (Appendix 2). The two indicators selected only at province scale were topography and tidal regimes. At the district scale, the population density, the soil composition, the river and canal network, the sediment deposition and the occurrence of tornadoes are considered as relevant LUCC drivers.
- 12 indicators for the province and 9 indicators for the district are rejected as the evaluation suggests they are irrelevant as causal factors of LUCC for the study area. The experts rejected 7 similar cause indicators both for the Ca Mau Province and the Tran Van Thoi District, such as the unemployment rate, the education level and the ethnicity, geology and temperature (Appendix 2).
- The distribution of the frequencies of the 1 to 5 ratings by all

experts in the two rounds is illustrated in Figure 4.4, highlighting that experts attributed a score of 4 over 33% of all indicators at two scales. Ratings 1 to 3 were given only to 33% of indicators for the province, but up to 49% for the district. A rating of 5 was given by 31% of the experts for the province whereas the corresponding figure is only 18% for the district.

3.2.2 Impact indicators

- In the first evaluation round, 36 out of 55 effect indicators obtained an average rating mean above 3.5 at the province level. For the district, 41 effect indicators rated above 3.5. In this round, the indicators for which the disagreement is most pronounced include the impact of LUCC on soil composition and income from the agri-aquaculture industry at the provincial scale; and the impact on acidic sulphate soils and poverty rate at the district level.
- In the second evaluation round, two additional effect indicators (acidic sulphate soils, and banana productivity) at province scale, and one indicator (income from aquaculture) for the district, have a rating mean above 3.5. Consequently, a total of 38 and 42 indicators were identified as relevant effect indicators for the case study at province and district level, respectively. 35 indicators are similar in both analysis scales. Additional impacts at the district scale include the evolution of the population density, welfare, immigration, and issues of drought and sediment.
- 17 indicators for the province and 13 indicators for the district were rejected as they were considered irrelevant. 10 of these indicators were similar at both scales and concerned the impact on the production of certain crops and animals (watermelon,

cassava, fruit, and goats) and on the temperature.

– The frequency distribution of the 1 to 5 ratings by the experts during the two rounds is shown in Figure 4.4. Experts attributed a score of 4 to more than 32% of all indicators. A rating from 1 to 3 was given to nearly 45% of indicators for the province and to 41% of indicators for the district. A rating of 5 was attributed to 22% and 27% of the indicators for the provincial and district scales, respectively. In total, the 3, 4 and 5 ratings are the most frequent ones highlighting the high degree of agreement of the experts with the pre-selected indicators. Results also highlight the high consistency between the two analysis levels, despite these being rated by different groups of experts.

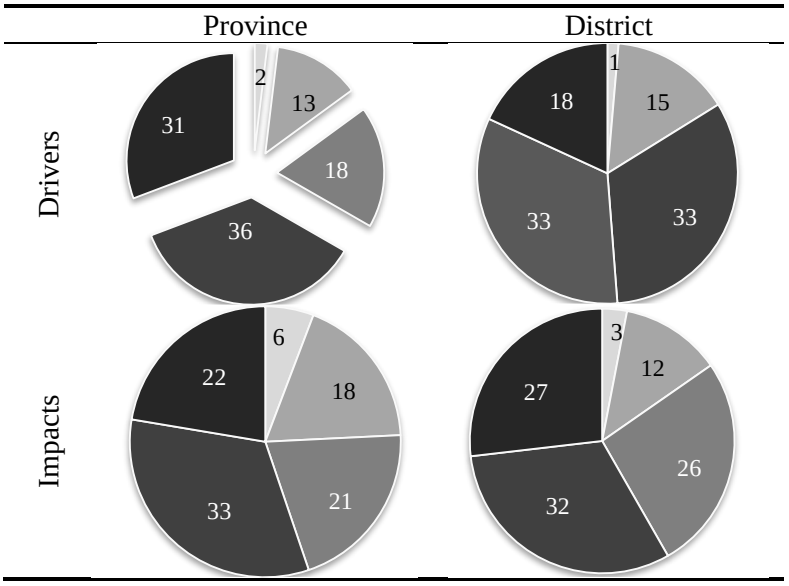


Figure 0.1 Ratings (%) by assessment level (1-5) of driver and impact indicators in the Ca Mau Province and the Tran Van Thoi District

Conclusions

1. Expert interviews is a useful one for the interdisciplinary.

2. Delphi method is the appropriate solution to analyze the causes àd effects.

3. It has a variety of advantages and disadvantages.

4. The process of expert selection, data analysis should be followed.

5. This method should be applied in different research objectives.

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