Exploring the future(s) of South East Asia:

Four scenarios for agriculture and food security, livelihoods and environments

A CCAFS/FAO/UNEP WCMC/NOMAFSI workshop in Ha Long Bay, Vietnam, 5-7 November 2013

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Cover photos by Elisabeth van de Grift and Rebekkah Sparrow-Lord

CGIAR RESEARCH PROGRAM ON Climate Change, Agriculture and Food Security CCAFS FAO EPIC ECONOMICS & POLICY INNOVATIONS FOR CLIMATE-SMART AGRICULTURE NOMAFSI UNEP WCMC

1. Introduction

The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), the FAO Economics and Policy Innovations for Climate-smart Agriculture (EPIC) Programme and UNEP/WCMC coordinated their activities in Southeast Asia in 2013 and beyond in order to develop and quantify participatory scenarios on the future of Food Security, Environments and Livelihood for three primary countries, the Kingdom of Cambodia, the Lao People's Democratic Republic and Viet Nam. The workshop was co-funded by the FAO EPIC program and by CCAFS Southeast Asia.

A regional workshop was organized in November 2013 in Ha Long with around 30 participants from the region during three days the participants developed qualitative scenarios on the future of Food Security, Environment and Livelihoods in the SEA region.

These scenarios are being developed in order:

1. to explore key regional socio-economic and governance uncertainties for food security, environments and livelihoods under climate change through integrated qualitative-quantitative scenarios describing futures up to 2050 – and combine these socio-economic scenarios with climate scenarios to understand the impacts of combined stressors;

2. to use these scenarios to test and strengthen policies and investments toward improved food security, environments and livelihoods under different socio-economic and climatic conditions. A main goal is the development of Climate Smart Agriculture investment proposals for northern Vietnam) facilitated by FAO EPIC.

The scenarios workshop documented in this report was the first in the region under the supervision and lead of CCAFS, FAO- EPIC and UNEP/WCMC. This workshop was co- organized with NOMAFSI, the key partner of FAO in Viet Nam.

Figure 1. Workshop participants. Photo by Rebekkah Sparrow-Lord

2. Scenarios: background

In South East Asia, socio-economic and climate scenarios are developed at the sub-continental (Cambodia, Laos and Viet Nam) level up to 2050 and used as a tool to guide policy development and investment proposal for public or private sectors.

Rather than attempting to forecast a single future, scenarios represent multiple plausible directions that future drivers of change take (figure 2). The CCAFS scenarios process focuses on contextual drivers of change for agriculture and food security – climate change and socio-economic changes (e.g. in markets, governance, broad economic developments, infrastructure).

The scenarios development process enables societal actors to participate in an analysis of the contextual factors of change for decision-making on food security, livelihoods and environments . Scenarios are an excellent tool for concrete policy and investment guidance - based on science-informed content, while also generating shared engagement and building relationships, knowledge exchange and commitments.

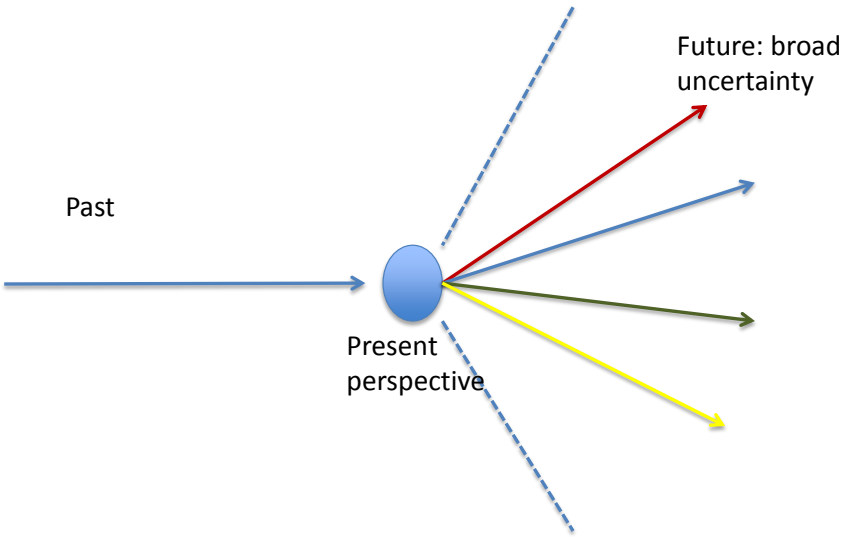

Figure 2 shows that rather than providing a single "most likely" forecast, multiple scenarios explore multiple concrete, plausible futures and what these would mean for food security, environments and livelihoods. This way, the set of scenarios engages with broad future uncertainty for the testing of policies, investments and research innovations.

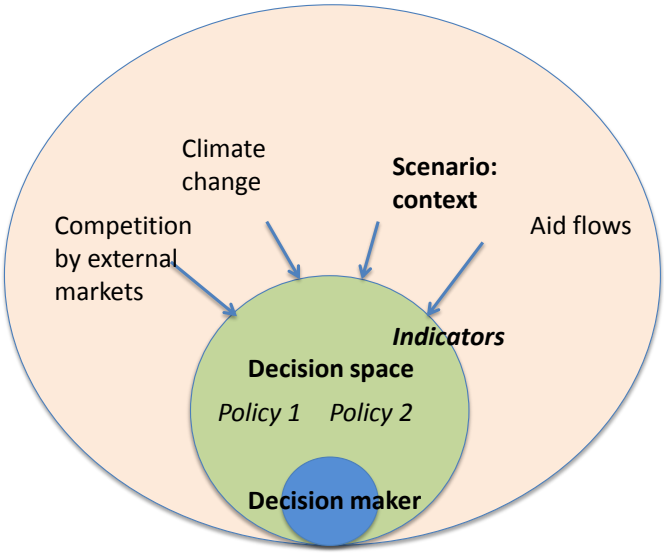

Figure 3 shows how the scenarios as used by CCAFS focus on the context for decision making – those drivers of change that are outside of the control of decision makers, such as climate change and large-scale socio-economic drivers. The scenarios then explore what changes in these drivers mean for issues that fall within the decision space of a decision-maker or group, such as rural poverty levels or crop yields.

The scenarios process enables relevant societal actors to participate in an analysis of the contextual factors of change for food security, livelihoods and environments (figure 3). The scenarios process seeks to integrate challenges to food security, environments and livelihoods (the CCAFS scope), and therefore involves participants with backgrounds in these fields, operating across different sectors. However, because the scenarios explore wider socio-economic contexts to food security, environments and livelihoods, an even broader scope of participants is relevant, such as involving stakeholders from planning departments and experts on broader socio-economic development.

These scenarios for Southeast Asia will be quantified using two global partial equilibrium models, IMPACT (developed by the International Food Policy Research Institute) and GLOBIOM (developed by the International Institute for Applied Systems Analysis). Socio-economic scenarios are combined with climate scenarios, in a process similar to that used by the IPCC-related global environmental change community. In this process, a socio-economic scenario can be combined with multiple climate scenarios and vice versa. Because of this, a socio-economic scenario that offers few opportunities for adaptation (for instance because of low investment in infrastructure and low government support of rural communities) will play out very differently under a low climate change scenario than under a high climate change scenario.

The fully finished scenarios are used in a range of processes driven by regional actors, that are aimed at testing and improving policies, investments and institutional arrangements (see section 6).

3. Scenarios development process

The approach used for the development of scenarios in this workshop is a version of morphological analysis that uses 4 instead of the 2 axes used in the normal, deductive scenario development approach, as well as allowing for the possibility of 3 driver states when qualitatively different states can be imagined that go beyond the normal 2 extremes used in the deductive method.

The benefit of this approach is a more transparent, systematic exploration of driver states that also includes more dimensions of systems in the principal framing of the scenarios. Participants outlined change factors, determine factor states and then a matrix is produced where the compatibility of the driver states is rated (not possible, imaginably possible, and possible). A MatLab program was then used by the facilitators (after the first day) to generate the most diverse scenarios (strings of factor states) from the set the participants have rated as possible and perhaps possible combinations. A set of 6 scenarios was presented at first from which participants choose the 4 scenarios they want to take forward.

The development of the scenarios was then conducted using narrative flowcharts where the narrative is developed backwards (explorative back-casting). On the last day, participants discussed what the scenarios mean for some key indicators of change that feed into the simulation work after the workshop.

In an open space session, participants also discussed next steps with regard to the use of the scenarios by FAO, CCAFS, UNEP WCMC and suggestions for other process. This last exercise fed into the objection of opening a policy dialogue through the elaboration and use of the scenarios.

The 3 days' workshop was divided into 8 main sessions/ exercises as follow:

Session 1. Speed meet: Future Change Factors

Participants organized themselves into pairs for ten minutes speed meets. Participants were asked to come up with future change factors related to the four elements of the workshop scope being agriculture, food security, livelihoods and environmental change. Each element will be discussed for ten minutes, with participants summarizing three to five factors on the colored post-its; different colors for the agriculture and food security, livelihoods and environment categories please see picture 2. We use "change factors" instead of "drivers", since drivers implies too much of a simple causality and may ignore feedbacks that in turn affect change factors.

Participants were then asked to put their contributions up on the wall and worked on which factors could be clustered. At the end of the exercise the participants came with 25 change factors (table 1).

Table 1 List of the 25 change factors generated by participants in the workshop and supplemented by drivers needed for the models.

25 Change Factors
Gross domestic product
Population
Crop yields
Agricultural yields
Effectiveness of protected areas
Environmental management
Infrastructure
Waste management
Food and availability of diet
Gap between rich and poor
Water availability
Technology development
Urbanization
Migration
Agricultural labor availability
Education
Deforestation
Overfishing
Biodiversity
Health
Human capital
Input costs
Pollution
Mining
Industry

Session 2. Clustering, ranking and selecting future change factors

In this second exercise the participants continued the clustering of factors until a clear set of factors emerges. These distinct factors are then ranked by each participant, using two types of numbered stickers, with a value of 1 to 3 for "relevance" and a value of 1 to 3 for "uncertainty". The top eight to ten factors in terms of both relevance and uncertainty are plotted on a relevance/uncertainty scale, and the top four factors are selected. Both criteria are important: if a factor is not considered to be highly uncertain it cannot give rise to diverse scenarios - but if it is not relevant the structuring of the scenarios will also be irrelevant.

At the end of this exercise the 4 change factors that were selected are:

- Markets
- Enforcement Capacity and regional Collaboration
- Agricultural Investment
- Land Degradation through Land Use Change

Session 4. Selecting factor states and outlining the factor compatibility matrix

In this session, participants organized themselves into four groups, each related to one of the four factors; the groups are pre-defined by the facilitators to ensure a balance in term of country representation and gender. Each group then comes up with 2-3 possible "extreme" states for the give factor (e.g. low and high economic development, or for a set of three: industrial, service or agriculture-based economy).

It was important that only "extreme" states emerge, in the sense that they are not intermediary, to give rise to truly diverse alternate futures that are dissimilar enough to be useful. The factor states were presented in a plenary session and discussed/refined. A factor state compatibility matrix was created that showed all combinations between factor states.

Session 5. Filling in the factor compatibility matrix

Participants split back up into the earlier four groups. Each group looked at the entire factor compatibility matrix and ranks combinations of states using the following scale: 0: not possible. 1: uncertain/disagreement. 2: possible. These three grades allow for a distinction between the driver states without falling into the trap of grading likelihood which would defeat the purpose of the scenarios development exercise.

Session 6. Choosing scenarios; beginning to develop scenario narratives

Through the Matlab program (OLDFAR) the facilitators team went from the factors- states exercise to the selection of 6 to 4 scenarios as shown in the below diagram:

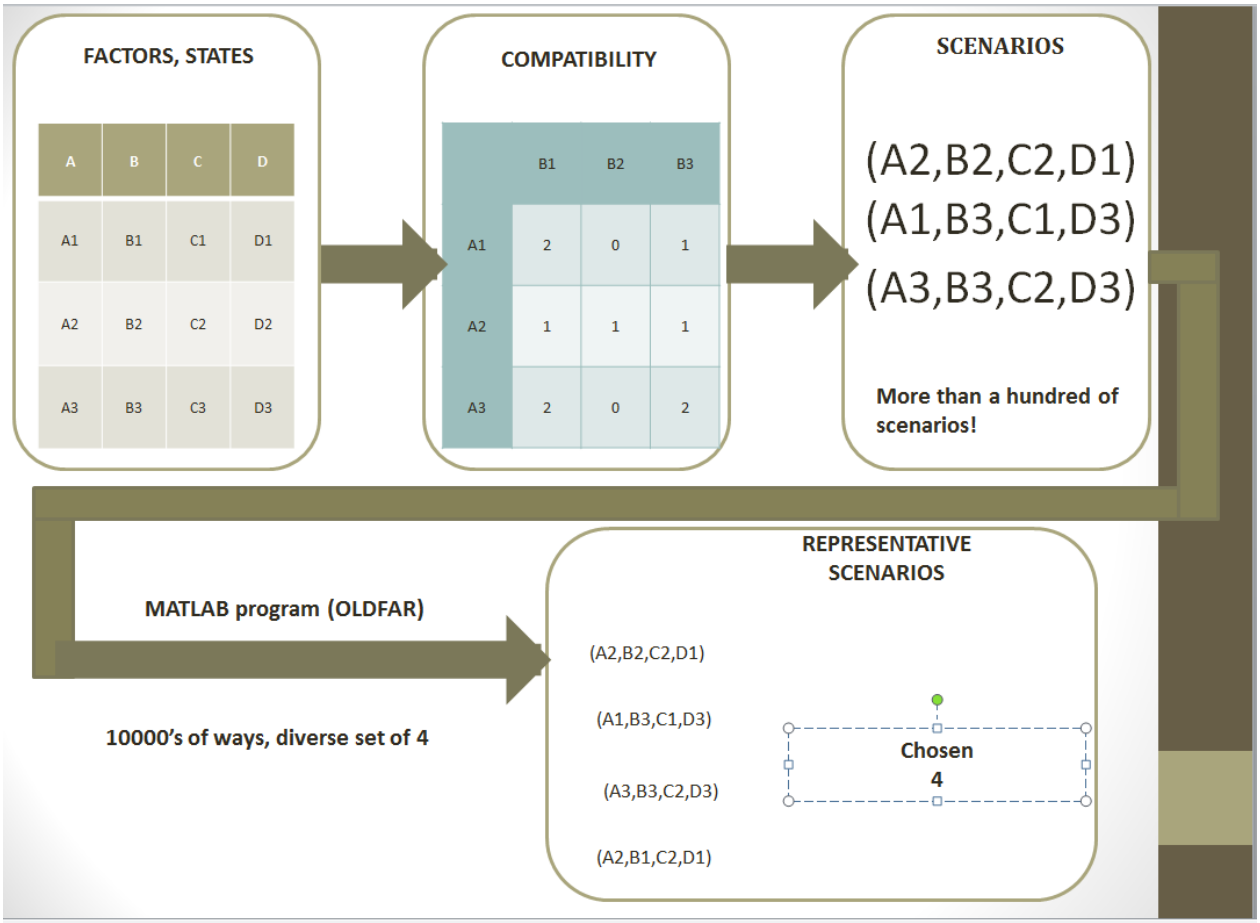

Figure 4. Steps in the scenario outlining process. Factors and states are outlined, and then the compatibility of these factors and states is assessed. Many scenario combinations are possible – the MATLAB program identifies the 6 most diverse scenarios, of which the 4 most useful are chosen by the participants.

Six potential scenarios (combinations of states for the 4 factors) were presented to the participants, and 4 preferred scenarios were taken forward. After this choice was made, participants were divided into 4 previously determined, diverse groups (expertise/nationality). Each group took the driver states of one scenario as the end state for that scenario up 2050. Working backward from 2050, the group's first imagined what the 2050 end state would look alike concretely and then used post-its containing story snippets to explain in a back-casting fashion what the pathway from the scenario in 2050 to the present looks like. Participants were encouraged to use newspaper headline-type language to make sure the story snippets were concrete and contributed to an engaging story. Table 2 combines the 4 scenarios selected. The "land degradation" category was originally more elaborate but it was simplified because it contained some elements of the policy choices that should be tested with the scenarios, and therefore could not be part of the scenarios themselves.

Table 2. The four scenarios emerging from the workshop process.

Factors	Markets	Enforcement capacity and regional collaboration	Agricultural investment	Land degradation through land use change
Land of the Golden Mekong	Common regulated market	Strong enforcement and strong regional collaboration	High public and private	Low
Buffalo, Buffalo	Unregulated	Weak enforcement and weak regional collaboration	Unbalanced: high private investment in business and research	High
The Doreki Dragon	Common regulated market	Strong enforcement and strong regional collaboration	Unbalanced: high private investment in business and research	High
Tigers on the Train	Protectionism and closed market	Strong enforcement and strong regional collaboration	Low public and private	Low

Session 7. Developing scenario narratives; discussing names; reporting back

Scenarios were developed by four breakout groups by first examining the combination of factor states in 2050 that made up each scenario, and imagining what kind of world this scenario would entail. Then, working backward from 2050 to the present, key changes and events in the scenario were established by the breakout group participants.

Key in this session was also that scenario names were drafted - these names are crucial for the communication of the scenarios and understanding their core dynamics and narrative.

Session 8. Semi- qualitative assessments

The 4 different groups were asked to fulfill for the scenarios they have been working on the following table in a group discussion lead by the facilitators (see table 3). Directions of change for an indicator were outlined with a 7-point scale, and questions about the logic for these changes in the scenario, the volatility of the changes, the confidence participants had that they could say something about this indicator, the level of agreement and the need for outside expertise and data sources were addressed when time allowed.

Table 3. Semi- quantitative assessment

Change (--- to +++),up to 2020	Change (--- to +++), up to 2030	Change (--- to +++), up to 2040	Change (--- to +++), up to 2050	Volatility	Logic for change	Confidence	Agreement	Expertise needed?	Data source

The results of the semi-quantitative indicators exercise can be found in Annexes 1 to 4.

4. Scenarios summaries

Land of the Golden Mekong

In this scenario, unification of Southeast Asia in terms of political, economic and environmental concerns slowly becomes a reality. Though challenges around urbanisation and migration initially increase, ultimately institutions become effective enough to enable improved development and environmental management. Aging populations and the lack of labour due to egalitarianism become a problem – migrants from poorer countries replace the regional population in the working class but are shunned and abused. Strength and inclusiveness of governance (at least for the autochthonic population) is the key source of the significant change in food security, livelihoods and environments that can be observed. Climate resilience is strong in that respect, though biophysical vulnerabilities remain significant, especially in the form of extreme events that still sometimes overwhelm the region's adaptive capacity. The migrants become the most vulnerable groups.

A longer description and the semi-quantitative indicators can be found in annexes 1 and 5.

Buffalo Buffalo; water flows uphill

In this scenario we start out in 2013 looking up. ASEAN agreements appear to be going ahead. Myanmar is starting to produce more and be more economically active. Moving to 2020 we start to see more problems: there are major corruption scandals that greatly weaken national governments. High oil and food prices due to global as well as local situation and increased demand for biofuels increases pressure for private sector to acquire land – increasing pressure on population that is dependent on farming for their living. Logging concessions to private industry lead to massive deforestation. Environmental change creates incredible regional tensions. ASEAN closes borders and cooperation between countries is lost. Food production is significantly decreased – migration and conflicts increase.2050 sees a situation of unsustainable agricultural intensification. There is a big plantation sector, greater emphasis on processed foods, but only the rich people in the country can afford it. There is huge environmental degradation. Social conflict is rampant. Local governance and civil society at times make some progress in solving problems, but they cannot overcome the overall declining situation.

A longer description and the semi-quantitative indicators can be found in Annexes 2 and 6.

The Doreki Dragon

In this scenario, the ASEAN-facilitated development of a regional market and the increasingly effective political focus on big business in all sectors, including agriculture, drives significant change. GMOs become the norm and are no longer exceptional – it's all just "food". Agricultural industrialisation develops to the degree that agriculture, while a massive source of growth, is almost no longer recognizable as such. Smallholder famers struggle more than ever, and very often fail, to maintain a livelihood – many become workers on highly industrial farms. Urbanisation is high. Environmental degradation and natural land conversion are extreme. Food security for the poor is very low, though food safety is stringent. The different societal classes are more divided than ever in terms of climate resilience with climate impacts being made significantly worse due to large-scale manipulation of the natural environment.

A longer description and the semi-quantitative indicators can be found in Annexes 3 and 7.

Tigers on a Train

This scenario sees Southeast Asia becoming increasingly collaborative regionally but also protectionist with regard to outside economic influences from China and other global actors. Riding on a time of high food prices in the first decades of the scenario, the region manages to use investments in agriculture that are not by themselves extremely high very effectively. The highly controlled region develops its focus from primary production more to agricultural processing, and eventually away from agriculture and toward industrialisation. Protectionist economic policies cause tensions with China and the need for continued negotiations. By 2050, some deep issues with the protectionist policies threaten to cripple the regional economy. In terms of climate resilience, this increased economic fragility threatens food security for the poorest who have felt the consequences of the shift away from agricultural development in recent decades.

A longer description and the semi-quantitative indicators can be found in Annexes 4 and 8.

5. Reporting and documentation of the workshop

This workshop benefited from high media coverage though blogs or newspaper articles.

- **Blogs:**

The world in 2050: on the front line: http://www.ciatnews.cgiar.org/2013/11/12/the-world-in-2050-on-the-front-line/

Other stories on scenario discussions:

Decision makers debate climate change in Southeast Asia

Framing the bigger picture

Thinking outside the box

Photographs from the workshop

- **Media links:**

Looking for clues to navigate climate uncertainty - Reuters Alertnet

Workshop focuses on food security - Vietnam News

Video documentation on scenario building

- **Pictures links:**

http://www.flickr.com/photos/cgiarclimate/sets/72157637540876486/

6. Next steps

First, the set of scenarios created in the workshop will be quantified by the GLOBIOM and IMPACT teams and combined with climate scenarios. These results will be presented to the process participants for review.

The fully quantified set of scenarios will be used as a tool for policy and investment guidance as well as institutional change in a number of ways:

- A second workshop will be led by FAO, focusing on reviewing the scenarios and using them to examine the feasibility of investment proposals for Climate Smart Agriculture
- A second workshop will be led by UNEP WCMC to review the results of land-use change modelling based on the scenarios and its implications for biodiversity, using these results to guide policies on agricultural development/environment trade-offs
- In the final open space session of the workshop, participants from each country suggested that close work with the ASEAN working group on Agriculture as needed.
- Participants from the different countries suggested national workshop with key ministers in each of the countries.
- An arrangement with the Ministry for Agriculture, Forestry and Fisheries of the Cambodian government is underway to use scenarios to test national adaptation planning in the coming years.

7. List of Annexes

Annex 1 Semi-qualitative assessment Scenario 1

Annex 2 Semi- qualitative assessment Scenario 2

Annex 3 Semi- qualitative assessment Scenario 3

Annex 4 Semi- qualitative assessment Scenarios 4

Annex 5 Scenario 1. The Land of Golden Mekong

Annex 6 Scenario 2. Buffalo, Buffalo

Annex 7 Scenario 3. The DoReKi Dragon

Annex 8 Scenario 4 Tigers on a Train

Annex 1 Semi-quantitative assessment Scenario 1: Land of the Golden Mekong

Sector	Change (--- to +++),up to 2020	Logic for change	Change (--- to +++), up to 2030	Logic for change	Change (--- to +++), up to 2040	Change (--- to +++), up to 2050
Gross domestic product/capita	+++	ASEAN-supported growth	++	Fairly sustainable growth continues	++	++
Technology effects on staple crop yields	+++	Initial improvements are made by government support	+	Slower once the first improvements have been made	+	+
Technology effects on cash crop yields	+++	Large investments	+++	Large investments	++	++
Area under protection	---	First decreases, but policies slow it down	-	First decreases, but policies slow it down	-	-
Environmental consciousness	++	Increases with education	++	Increases with education	++	++
Infrastructure development	+++	Large investments	++	Large investments	++	++
Waste Management	0	Little attention given; increased economic development	0	Policies change	+	+
Food and availability of diets	+++	Fast improvement	0	Then steady, slow improvement	+	+
gap between rich and poor	+	Increased with more overall money available	+	Rising middle class	+	+
Water availability	-	Economic development puts pressure on water availability	--	Improved policies but still increased pressure	-	-
Urbanization	+	As current	+	As current	+	+
Migration	++	Increases to fill labour gaps	+++	Increases to fill labour gaps	+++	+++

Agricultural labour availability	-	Decreases with urbanisation	-	Decreases with increasing middle class	-	-
Education	+	Increased investment	+	Increased investment	+	+
Deforestation	++	Increases with economic development	++	Slowed by policies	+	+
Overfishing	+	Increases with economic development	++	Eventually mitigated by policy	+	+
Biodiversity	-	Decreases with land use change	--	Eventually mitigated by policy	-	0
Health	0	No initial increases	0	Eventually increased by health policies	+	+
Farm input costs	+++	Increase with increasing fuel costs	+++	Government regulations	++	++
Pollution	+	Largely unmitigated	++	Government struggles to mitigate pollution	++	++
Mining	0	No change	0	No change	0	0
Industry development	++	Strong with development	++	Strong with development	++	++
Gender equality	0	Takes long to change culturally	0	Eventual changes through education	+	+
Rural/urban poverty levels	++	Rural areas left behind	+++	Eventually stabilizes	0	0
Diversification of rural incomes	+	Increases with more off-farm incomes	+	Increases with more off-farm incomes	+	+

Table A1. Semi-quantitative information for scenario 1. Land of the Golden Mekong. The meta-questions about agreement etc. were skipped by this group. Logics of change supplemented by narrative.

Annex 2 Semi-quantitative assessment Scenario 2: Buffalo, Buffalo

Factor	2014-2020 (--- to +++)	Logic for change	2030-2050 (--- to +++)	Logic for change	Volatility	Do we agree? (--- to +++)	Are we confident we can outline this indicator (--- to +++)?
Gross domestic product/capita	+	there is positive economic growth but it isnt as fast as it could be because of global economic slow down	0	Initial grwoth cannot be sustained, so we have a plateuing out even though there is private sector investement because there are crises (environtmental, food)	++	-	+
Technology effect on staple crop yields	+	Due to investment of private sector but not too much because they are already at the highest yield potentials in many places	-	Because of land degradation	+	-	++
Technology effects on cash crop yields	++	Due to investment of private sector but not too much because they are already at the highest yield potentials in many places but cash crops higher investment so trajectory is better than staple crops	-	because of land degradation	+	-	++
Area under protection	-	No enforcement capacity, private sector running rampant	--	Drought and disaster adding to lessened area under protection	++	+	++

Environmental Consciousness	-	Because people are out for themselves and do not have the resources to care about the environment	--	Because people are out for themselves and do not have the resources to care about the environment	+	+++	++
Infrastructure development	+	Things have not fallen apart yet	--	Private sector only does development for themselves, and there is no govt to develop	+	little disagreement	+
Waste management	-	Follows environmental conciousness, lack of education	--	People manage their own waste and do not have the capacity	0	some disagreement	+
food and availability of diet	+	we have slight increases in availability but nutrition starts to go down	-	With the food crises after the drought, there is a decrease in availability and nutrition continuous to go down	+	++	+++
gap between rich and poor	++	Already increasing, private sector out for themselves	+++	Situation getting worse with natural disaster	0	+++	+++
Water availability	-	China is damming, climate change	--	Further exacerbated by a major drought and conflict, mismanagement	++	+++	+++
urbanization	+	Already urbanization and it will continue with people moving away from farming	+++	With natural disasters, land degradation, people move to the city for employment opportunities	++	little disagreement	++
migration	+	Some migration because of labour movement	++	Climate change, drought, land degradation, people move out	++	+++	++
Agricultural labour availability	-	Related to urbanization and yield, with people moving to the	--	Increases because yields go down and so people cannot make profits from	++	+++	++

		city less people working on farms		farm income			
education	0	People are education now but the govt cant invest	-	It decreases because the govt does not have the capacity to provide and the private sector does not invest, and people are in camps so vast majority does not have access to education, only the rich might	+	some disagreement	+
deforestation	++	No investment, no collaboration, lack of education hill tribes clearing trees	+++	Drought and so land pulled into whatever else is needed	0	+++	++
overfishing	++	High levels following deforestation, and it is already happening	+++	There will be no fish left by the end	0	+++	++
biodiversity	--	Correlated with deforestation, overfishing, and education	---	Correlated with deforestation, overfishing, and education	0	++	++
health	-	correlated with nutrition and waste management and sanitation, education and weak govt	---	correlated with nutrition and waste management and sanitation, education and weak govt	++	some disagreement	++
farm input costs	+	Increasing lack of resources like water and land may lead to increased costs but this might only be offset somewhat with private investment for eg in the case of fertilizer	++	Increasing lack of resources like water and land may lead to increased costs but this might only be offset somewhat with private investment for eg in the case of fertilizer	+	+++	++

Pollution	++	High level of land degradation correlated and because private sector is out for profits	+++	High level of land degradation correlated and because private sector is out for profits	0	+++	+++
Mining	++	High levels of exploitation	+++	High levels until there is none left	0	some disagreement as to speed	++
Industry Development	+	Some industries will increase because of high private sector investment but those with low profits will decrease	+	Some industries will increase because of high private sector investment but those with low profits will decrease	+++	+++	++
Gender equality	0	Things will remain the same, not affected by economic conditions	0	Things will remain the same, not affected by economic conditions	0	+++	+
Rural/urban poverty levels	+	Because degradation of land and water resources	++	Because degradation of land and water resources	+	+++	++
Diversification of rural incomes	-	Only private the sector investment only in certain thing	---	Only private the sector investment only in certain thing	+	+++	++

Table A2. Semi-quantitative information for scenario 2: Buffalo, Buffalo

Annex 3 Semi-quantitative assessment Scenario 3: the DoReKi Dragon

Sector	Change (--- to +++),up to 2020	Logic for change	Change (--- to +++), up to 2030	Logic for change	Change (--- to +++), up to 2040	Change (--- to +++), up to 2050
Gross domestic product/capita	++	GDP increase driven by ASEAN	++	GDP increase driven by ASEAN	+++	+++
Technology effects on staple crop yields	0	No attention given to staple crops	0	No attention given to staple crops	0	0
Technology effects on cash crop yelds	++	At that time the production requires modern techniques for larger scale farming. When we work in large scale we will need bigger companies who will provide inputs for production (fertilizers etc.) .	++	At that time the production requires modern techniques for larger scale farming. When we work in large scale we will need bigger companies who will provide inputs for production (fertilizers etc.) .	++	++
Area under protection	-	Decrease because of expansion of land use; lack of policies	--	Decrease because of expansion of land use; lack of policies	--	--
Environmental consciousness	-	There are protests against pollution	+	There are protests against pollution	+	+
Infrastructure development	++	Government + private investment into infrastructure	++	Government + private investment into infrastructure	++	++
Waste Management	--	Massive pollution	--	Massive pollution	--	--

Food and availability of diets	-	The poorest are still food insecure	-	The poorest are still food insecure	-	-
gap between rich and poor	++	Policies favour wealthy	++	Policies favour wealthy	++	++
Water availability	-	Water resources scarce	-	Water scarcity becomes a real problem	--	--
Urbanization	++	Smallholders change livelihoods	++	Smallholders change livelihoods	++	++
Migration	++	Labour migration between the countries	++	Labour migration between the countries	++	++
Agriculutural labour availability	-	Labour has migrated out of rural areas; ex-smallholders become labourers	--	Labour has migrated out of rural areas; ex-smallholders become labourers	--	--
Education	+	Not for the poorest	+	Not for the poorest	+	+
Deforestation	++	Because of land use expansion, lack of policies	++	Because of land use expansion, lack of policies	++	++
Overfishing	++		++		++	++
Biodiversity	--	No protection policies	--	No protection policies	--	--
Health	+	Not for the poorest	+	Not for the poorest	+	+
Farm input costs	+	Fuel prices, energy prices go up	+	Fuel prices, energy prices go up	+	+
Pollution	++	Air and soil pollution leads to protests	++	Air and soil pollution leads to protests	++	++
Mining	++	Goes up with industry	++	Goes up with industry	++	++

Industry development	++	Main focus of policies	++	Main focus of policies	++	++
Gender equality	0	No specific attention to this in policies	0	No specific attention to this in policies	+	+
Rural/urban poverty levels	+	Rural poverty remains high, gap with regard to urban poverty	+	Rural poverty remains high, gap with regard to urban poverty	+	+
Diversification of rural incomes	+	Farmers are forced to diversify	+	Farmers are forced to diversify	+	+

Table A3. Semi-quantitative information for scenario 3: The DoReKi Dragon, supplemented by narrative outline.

Annex 4 Semi-quantitative assessment Scenario 4: Tigers on a Train

Factor	2014-2030 (--- to +++)	Logic for change	2030-2050 (--- to +++)	Logic for change	Volatility	Do we agree? (--- to +++)	Are we confident we can outline this indicator (--- to +++)?
GDP per capita	+	driven by agriculture (high prices)	+	population densities are increasing (GDP shift to industry, but the closed market. Strong regional market due to population increase, more services provided)		no	not really
technology effects on stable crop yields	++	we have mechanization and some investment in development due to high prices	no change	low investment keeps yield improvments constant		yes	yes
technology effects on cash crop yields	++	we have mechanization and some investment in development due to high prices	no change	low investment keeps yield improvments constant		yes	yes
area under protection (for biodiversity; national parks)	-	high incentive to grow on protected land because of the market prices	(- or +), probably +			not really	maybe not
environmental consciousness	+	start having policies to develop more sustainable systems	++	educated people, we have enforcement, low land degredation		yes	yes

Infrastructure development	++	investment in processing and also transport methods for agriculture	++	industry infrustructure devleopment		yes	yes
Waste management							
food and availability of diet	+	higher food prices but high investment in agriculture. Food production increases but people in urban areas may not be able to afford	-	move out of agriculture, even though regional collaboration to allow for food storage and famine control		sort of	not really
gap between rich and poor	+	related to the other issues	-	related to other issues		yes	yes
Water availability	-	more water being used for agriculture	0	ag water goes to industry (Water pollution should follow with the pollution, from industry)			
urbanization (city building)	++	high urbanization due to more intensification for ag	++	farmers leave the rural areas to find jobs, govt zones areas for more industries near the land (these become bigger cities, rise of medium sized cities dude to patchy industrialization)	no	yes	yes
migration (people moving within the region and from rural areas to urban areas)	+: region to the world +:between countries in region	wi region: more collaboration starting to build	from region to world:+ ; wi region:++	wi region: zonal planning increases the urban zones and more collaboration allows for more		maybe, yes	

				regional traveling and migration			
Agricultural labour availability	-	no jobs in ag due to mechanization	--	low investment in ag all going to ag sector		yes	
education							
deforestation	++	deforestation is illegal but the not protected land will be higher (these will be clear cut first)	-	more awareness and enforcement		slight disagreement (+ or ++)	
overfishing	+	increase in over fishing	+	more demand in the cities for protein			
biodiversity	-	not much enforcement	+	overfishing still takes place, more awareness			
health							
farm input costs	+	input prices increase (this is a trigger)	+	there is no investment but input prices are still increasing		mostly	yes?
Pollution	+	pollution from ag inputs	-	more industry but they are pollluting less than they did (more technology advancement), ag pollution reduced		not really	
Mining							
industry development							
gender equality	+		+				

rural/urban poverty levels (ratio of urban to rural poverty)	-	higher urbanization leads to more urban poverty	+	more industry which means cities incomes increase and low investment in agriculture means that more rural poverty			
diversitfication of rural incomes	no change	more focus on cash crops rather than staple crops, more diversity related to higher income	+	related with tourism and services, incomes from ag processing			
Protectionism	only for goods not for borders						

Table A4. Semi-quantitative information for scenario 4: Tigers on a Train

Annex 5. Narrative for Senario 1: Land of the Golden Mekong.

Scenario 1

- **M**arket: *Common and regulated*
- **E**nforcement capacity and regional collaboration: *Strong enforcement*
- **A**griculture Investment: *High Investment from Public and Private*
- **L**and degradation through land use change : *Low*

Land of the Golden Mekong

SEA Union became an unique institutional entity combining different countries primary Laos, Cambodia and Vietnam which shared a common vision on energy, water and natural resources development that leads to an effective land management with clean cities, water, safe food and large forest areas.
The Golden Mekong Union has a common currency, a central bank where borders are open and labor could move freely. In the Golden Mekong Union as the population gets more educated top local universities are flourishing , attracting even foreign students. We have a lower rural population due to mechanization and the labor. Agriculture represents, by 2050,less than 10% of GDP.
The population is educated with a high environmental and social consciousness promoting and living in the best democratic model with adequate and affordable access to resources.

Figure A1: Scenario outline

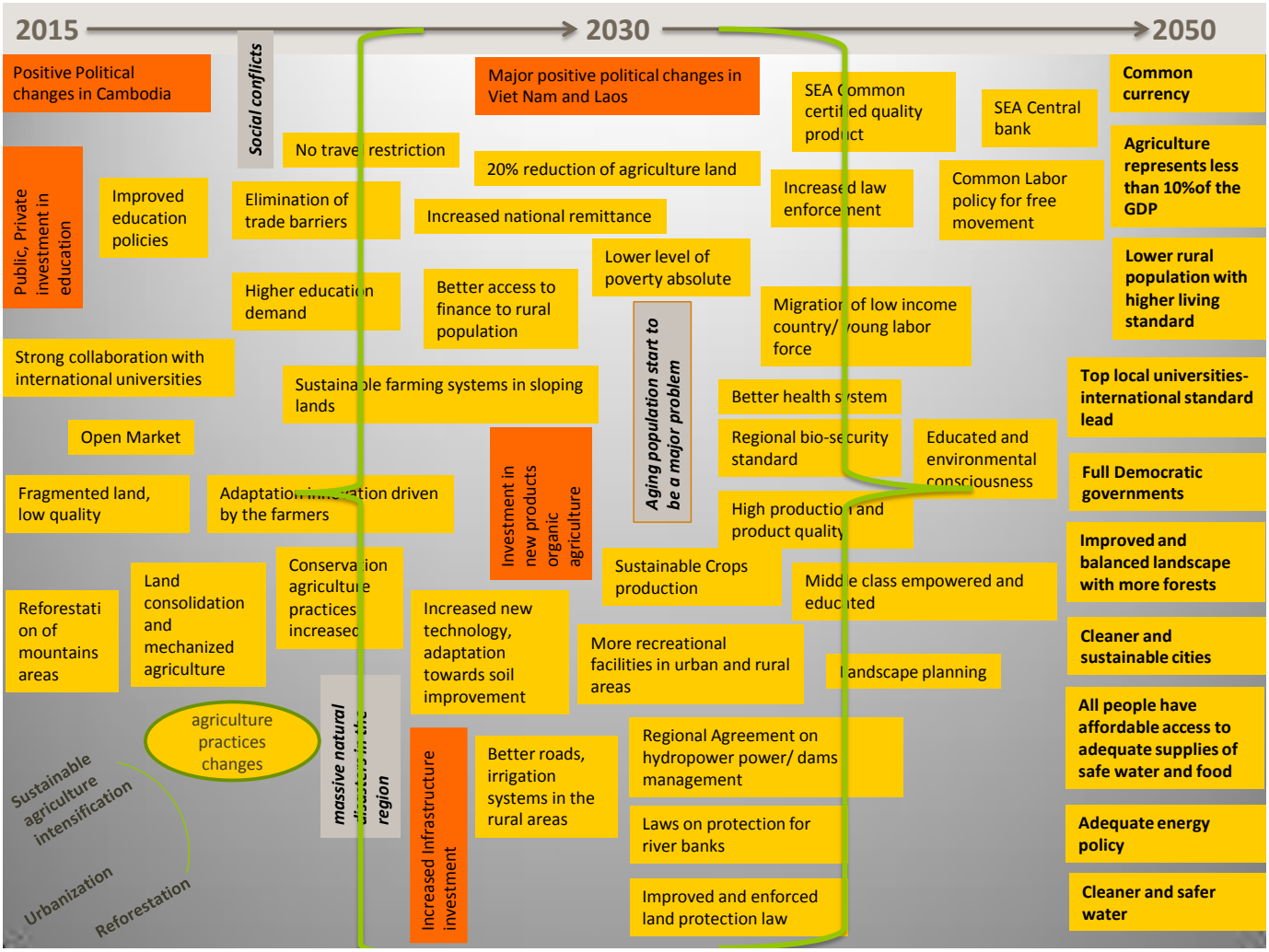

Figure A2: Scenario time line

Annex 6. Narrative for Senario 2: Buffalo, Buffalo

Scenario 2: buffalo buffalo; water flows uphill.

Unregulated markers, weak enforcement and weak regional collaboration, unbalanced high private investment in business and research, high land degradation and land use change.

In this scenario we start out in 2013 with a rather positive situation and outlook. ASEAN agreements appear to be going ahead with open borders, free movement of goods and labor. Myanmar is starting to produce more and be more economically active. There is investment in the region – although not that much. There are some clouds on the horizon however. Already there are problems with environmental degradation – for example, siltation of Mekong river is becoming an increasing problem for downstream people.

Moving to 2020 we start to see more problems arise. First there are major corruption scandals that greatly weaken national governments. Terrorist and cyber attacks reduce people's willingness to exchange information. Environmental degradation leads to loss of production land which is aggravated by sea level rise. Navigation on waterways is increasingly disturbed by high siltation.

Moving towards 2025, the culmination of all these problems leads to slowdown (reduction?) in economic growth and then lower tax revenues and reduction of already low public investment. China becomes more aggressive in the use of Mekong water – taking up 75% of the total supply through construction of dams. Water starts to flow uphill. Fish production is reduced. A global power shift from west to east – increases the power of china and aggressive behavior in the area. Greater conflict over South China Sea means there's even less regional collaboration. In the countries the government reduces services delivered – there is some movement at the local level and civil society to fill the vacuum but not strong enough.

Moving towards 2030, Vietnam Laos and Cambodia try to develop a water sharing agreement for the Mekong in the face of increasing conflicts between upstream and downstream users and increasing degradation. High oil and food prices due to global as well as local situation and increased demand for biofuels increases pressure for private sector to acquire land – increasing pressure on population that is dependent on farming for their living. Logging concessions to private industry lead to massive deforestation. Wildlife smuggling and trade increases due to weak capacity to enforce laws.

Climate change effects start to really take hold – sea level rise, salinization of rivers, increased frequency of disasters, flooding in red river delta and Mekong river. Large numbers of people start to migrate – within and external to the country. China is increasingly militaristic.

In 2035 a great drought hits the region, devastating agricultural production. The intensity of the drought is greater than once in a hundred years. This creates incredible regional tensions. Laos sides with China – so the regional water agreement with Vietnam and Cambodia collapses. In response, ASEAN closes borders and cooperation between countries is lost. Migration increases –within and externally, but the closed borders means many people end up in refugee camps on the borders. Cambodia calls for help and collaboration to solve the problem and some policy-makers in all countries try to take action – but they are unable to be effective. Food production is significantly decreased – migration and conflicts increase.

People become increasingly suspicious and unwilling to cooperate in any way. Population growth decreases – people have no confidence in the future and have fewer children. The weak governments try to take actions to solve problems but it is too late and they are too weak.

We arrive in 2050 with a situation of unsustainable agricultural intensification – high levels of land degradation and deforestation, but with much of the benefits going to private investors – both within and external to the countries. There is a big plantation sector, greater emphasis on processed foods, but only the rich people in the country can afford it. The highland areas experience uncontrolled exploitation of forest and natural resources – resulting in huge environmental degradation. Much of the land of the country is contracted to private sector for export crops development – this creates much pressure for access to land and big conflicts and poor farmers depending on farm production are hurt. Food insecurity is high. There are huge losses of biodiversity, and big increases in GHG emissions. Social conflict is rampant. Local governance and civil society at times make some progress in solving problems, but they cannot overcome the overall declining situation – their effect is unstable.

Water is flowing uphill, draining the wealth and well-being of the region. Buffaloes butt heads as each tries only to take care of themselves. This world is a bleak and selfish place to live in.

Annex 7: Narrative for scenario 3: the DoReKi Dragon

Scenario 3 (Common regulated Market – Strong enforcement and strong regional collaboration – Unbalanced: high private investment in business and research)

2013: all of the asean countries will take .. Participants of all the countries will … all of the single farmers will organize small farming groups. Because we switch to small farming groups so we need…. Related to small agriculture. Therefore land concession will be granted to private sector. It will lead to land concentration to some groups. Then the productivity of each group will increase. When we have a larger scale production and group farming then we will have larger scale production. At that time the production requires modern techniques for larger scale farming. When we work in large scale we will need bigger companies who will provide inputs for production (fertilizers etc.).

2020-2030s when we concentrate production in big companies then small farmers will switch to another career (other live hoods). While we have large scale production environment will be harmed, agriculture diversity will be reduced. Amount of food crops will decrease. Then they will have to deal with unemployment because farmers will lose their land. Then there may be conflicts between governments and farmers that will lose their land , other social issues. Competiveness of small farmers groups will increase. Then lowly competitive farmers will be taken over by big farmers. Foreign companies will take over some of small companies.

The farmers will be become employees in the larger companies. This may lead to labor migration from Vietnam to Cambodia and Laos.

Need to build irrigation systems

High value crops export will increase, as shift in production from staple to industrial corps

Cambodia voice: more consciousness from Governments about reforestation and land concessions … but unsure how big companies will influence, but the scenarios say heavy land consolidation and degradation. In terms of fishery, inland fishery form inland lakes, lots of future challenges when dams are in effects will reduce water availability in Mekong. Clearly this will cause water crisis. The strongest hit country will be Vietnam which is at the end of the river.

Since the region signs the FTA this implements, the transformation of agriuculre us happening in, the export of high value crops will be sign increasing,e.g. coffee and tea export.

Small groups get stronger influence on investment so that by 2020s there will be more investment of big MNC in the region, more open legal framework for land concessions, land ownership. In particular in VN strong pressure on privatization of land comes in place… bigger farmers. Will create middle sized farms, but fives spaces for larger mnc and foreign investors. From 2020s stronger influence of private sector, not only lobbying, private will be part of decision-making bodies. So that in the 2030s the land will be in the hand of mncs who will be main drivers of productivity and productions, will have influence labour reform in the region. If pro-poor policies remain, they will be included in 2030 reforms.

Due to high value mono culture increase, this starts profitable biofuel crops, that will increase over time as fossil fuels will be more expensive, companies will find this attractive business.

Land concentrated to large farms. Young labour from rural areas will come to cities

Existing organic farms may continue on small scale as niche farming, expensive.

2030-2040s the power of large companies will increase, pollution worsens leading to soil + water crises. With large scale production the productivity will increase. All Indochina reach middle income status. Agriculture will focus on some main crops. Big companies will work for their profit not for social welfare. With market oriented will production will exploit environment need to think about renewable energy.

During the water and energy crisis will require the region to agree on better scenarios (regional treaty) to solve the problem. In this time ASEAN is getting richer so have to think about protecting the water and energy for inventing better solutions.

Air pollution: the region suffers from severe air pollution, people starts recognizing harmful effects of air pollution and air pollution driven disease will become more commonly found in hospitals. At this period, people also start wearing masks … the region becomes major exporter of masks. The heavy metals in soil pollutions, no more vegetables can be exported to other regions as they are introducing tighter and stricter food regulations.

Forest: Cambodia loses 40% of forests, VN converts 40% forestry to agriculture e.g. rubber and palm oil plantation

Large foreign agriculture companies will come here, some small farmers remain on poor soils, but good soils taken for food production by big companies. Industrialization increase. Agricultural labour availability reduces. Urbanization stronger than in 2020s. Focus on cash crops.

2040-2050s the agricultural production is industrialized. Public-private partnerships will be very strong, and governments will work together with large cooperation's for private benefits. The Governments will set the legal framework for controlling the market

The thinking shifts: we are doomed. Water unavailability the region gets together about water treaty and soil erosion control.

Regional institute to control the processes, will be influenced by groups of lobbying actors (mncs) in 2040s. by 2040s the mncs take of their control of agriculture sectors, the governments will only implement policies, as an instrument of the mncs.

Agriculture companies fewer but bigger scales due to consolidation of land. Geographical specialization of monocultures, land degradation.

2050: We will have regional institutions and legislation no longer national that will support agricultural production. National policies will cover all issues: gender equality and all other issues. The agriculture model (the consolidation) from 2030s-2040s will be enhanced in 2050. Due to specializations in some crops will be exported, need to import other crops.

Will focus on competitive advantage production (crops). From 2050s quantity oriented to quality oriented.

Farm labour will reduced, rural population significantly reduced .

Region becomes economically and socially consolidated, into one currency DOREKI. All consolidated into one document, including gender policies.

Inland fishery reduce, 70% of fishery gone

Agriculture land is reduced, produce only cash crop for export. VN will import rice.

Already entered high income status (developing country status) but inequality stays. It is a very pro business region, supporting large company interests, and environmental degradation worsens.

High use of inputs that are continues to contribute to pollution.

Due to scale of production and increasing fossil fuel price, use of farm wastes become the interest of agribusiness, so cogeneration will be largely utilized.

Annex 7: Narrative for Scenario 4: Tigers on a Train

This scenario is characterized by a highly protected region and a closed regional market, and strong enforcement of regulations, ending in low agricultural investment and low soil degradation.

The tiger is a strong, dominant animal, representing the strong policy enforcement in Vietnam, Laos and Cambodia. These tigers are on a train together because they follow a linear, protectionist policy, not deviating when problems with this approach arise.

In the early decades of the scenario, however, the narrative starts with high agricultural investment in a region that is still focused strongly on primary production. The region then shifts to agricultural processing and eventually moves to a strong focus on industrialization combined with a highly protected market.

Up to 2030

Food prices are high, driving demand for cash crops. This relates to issues of land degradation, land grabbing. Damage by natural disasters is high. Labour force availability is decreasing.

Governments facilitate private sector investment in research and implementation of new technologies to increase yields, and strongly on improving the processing of agricultural commodities.

People in rural areas are asking for more effective enforcement and regulation of agricultural extension work.

Urbanization continues, with more and more people leaving rural areas.

The focus on processing increases over time.

2030 and beyond

The importance of agriculture for GDP is decreasing and investment in agriculture is lower while other sectors increase, particularly industries. Policies shift along with this trend, facilitating growth in other sectors.

However, while budgets decline, implementation of agricultural development is still strong and well-regulated. This means that government support for rural livelihoods works very effectively considering the resources that are available.

The protectionist market policies of the SEA region cause tensions with foreign interests and have to be re-negotiated. However, protectionism still characterizes the region up to 2050 and by this time problems with food security come up and the region is fragile to an extent because of its lack of openness to other markets.

By 2050, therefore, voices in the region are asking for a re-negotiation of trade agreements. There is a lot of uncertainty about the future of the region at this point.