

Generated Social Scenarios and Basin Conditions for the Final Integration

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1. Introduction

The ultimate goal of the project ICCAP is not to provide accurate forecast of the impact of climate change but rather to assess vulnerability of the agricultural production system through simulating its response towards climate change. Since agricultural system is an interface between nature and human activity, we needed some assumptions on socio-economic condition and its reflection on land use in the 2070s, especially to calculate water resource availability and its consequences.

Presently there is no sound scientific methodology for projecting socio-economic settings of a region or a country in the 2070s. Also, according to the methodology that we chose, there were additional limitations as shown below.

- 1) We used pseudo warming climate data for obtaining better agreement between projection data and observation data. We did not downscale data for the years between the 1990s and 2070s.
- 2) We did not have international trade condition of Turkey in the research frame.
- 3) Adaptive capacity of future crop variety was unpredictable.
- 4) The 2070s was more than 60 years away and assuming any economic equilibrium in the basin was not realistic.

Therefore we decided to generate social scenario qualitatively through discussion among the participants, based on impact assessment of climate change carried out individually by each subgroups assuming present land use.

2. Assumptions and basic frames for scenario generation

2.1 Assumptions

Our scenarios were created with assumptions below.

- 1) Although A2 scenario was assumed for climate data, we did not reflect the social setting of A2 scenario to Seyhan River Basin.
- 2) The scenarios were basically created based on the results of impact assessment with the present land use and the present social setting.
- 3) We tried to create extreme scenarios rather than optimal adaptation scenarios for testing the adaptive capacity of the system.
- 4) We did not consider farmers' adaptation by change of crop variety and assumed that that physiological response of crops would be same.
- 5) The effect of pest and disease were not considered.
- 6) The effects of domestic and international trades were not considered.
- 7) We did not consider demographic change and its potential consequences.

2.2 Basic frames of scenarios

To develop scenarios, the order of chain reaction was determined from upstream to downstream and from natural response to human response.

- 1) Climate condition.
- 2) Natural vegetation condition.
- 3) Cropping pattern and productivity of rain-fed crop land.
- 4) Degree of water resource development.
- 5) Available water for the irrigated agriculture.

- 6) Cropping pattern of the irrigated area.
- 7) Groundwater use in the irrigated area.
- 8) Water budget and salt water intrusion in the irrigated area.

2.3 Basic direction of change

At the time of scenario generation in the summer of 2006, we were aware of the following impacts of climate change.

- 1) Seyhan Basin would receive approximately 25% less precipitation in winter time and temperature would rise 2-3.5 °C in the 2070s.
- 2) Natural vegetation would be subject to change but transition would occur very slowly. The effect of forest policy may have more significant impact on vegetation coverage until the 2070s.
- 3) The productivity of wheat was likely to decrease (in the final report, it is reported to increase).
- 4) Crops would have shorter growing periods due to increased photosynthetic productivity with elevated CO₂ and they would have increased evapotranspiration per day because of higher temperature.
- 5) Accession to EU would have large impact on land use in the basin.
- 6) Degree of sea water intrusion would be limited to a few kilometers from the coast.

3. Generated scenarios

3.1 Main setting of the scenarios

We developed three different scenarios as shown below.

- 1) Scenario 1: a passive and low investment scenario for agricultural production. Rather than making additional investment, farmers choose the crops that they can grow with available resource. The maintenance level of infrastructure declines from present. Phase IV area is not irrigated.
- 2) Scenario 2: a pro-active and high investment scenario for increasing productivity. For counter-acting the decrease of water resource, additional reservoir construction is carried out. The maintenance level of canal improves from present. Phase IV area would be irrigated.
- 3) Scenario 3: the same setting as the scenario 2.

Additionally, groundwater uptake occurs in the low lying area. On the average of whole LSIP, 150mm of new groundwater use occurs.

The scenarios 1 and 2 were set as contrary to each other. The scenario 3 was basically same as scenario 2 except for the great increase of groundwater use in the delta plain. Table 1 shows the brief summary of scenarios.

3.2 Detailed setting of the scenarios

Here are some additional explanations for the details of scenarios.

- 1) Natural vegetation: in the scenario 1, vegetation cover was assumed to remain same as present with conservation efforts. Projected decrease of evergreen conifer forest was reflected on the scenario 2 and 3. The decrease was assumed to be 20% of present (although quantified as 45% of total at final report). The effect of elevated CO₂ was not incorporated. The impact of grazing on vegetation cover was not incorporated.
- 2) Winter wheat: scenario 1 assumed relatively lower productivity and lower market competitiveness in the middle reach of the basin and therefore projected 100% of cultivated area being converted to pasture. The scenario 2 and 3 assumed 25% of wheat cultivated area being converted to irrigated field (see below for details). The rest would again turn into pasture.
- 3) Water resource development: different degrees of upstream development were tested. Out of all wheat cultivated area in the middle reach, we tested 50%, 25% and 12.5% of it being converted to irrigated field and compared reliability for the water demand of the LSIP as shown in Fig.1. We obtained severe but not absolutely water deficit condition with the case of 25% (30,000ha). The reliability for that case is shown in Fig.2. For this area, assumed crops were maize (75%) and citrus (25%).
- 4) For irrigated agricultural area in the LSIP, Umetsu et al. used the calculated available water and projected land use change in the 2070s using expected value-variance (E-V) model. In the scenario 1, the coastal area called "phase IV" would not be irrigated and water use efficiency would be lower than present because of less

Table 1 Summary of scenarios

	Changing factors	Present	Scenario 1: Less resource deriving, low water stress scenario	Scenario 2: Pursuing productivity, high water resource development scenario	Scenario 3: Pursuing productivity, high water resource development scenario
Natural vegetation (non agric. Land)	Vegetation cover	No change	No change	20% decrease in evergreen conifer forest	20% decrease in evergreen conifer forest
Agricultural land (rain-fed)	Wheat cultivated area in the middle reach	100% cultivated	100% converted to pasture (abandoned)	25% converted to irrigated agricultural land. 75% converted to pasture	25% converted to irrigated agricultural land. 75% converted to pasture
	Construction of additional dam		No	Yes	Yes
Agricultural land (LSIP)	Available water (MRI)	585	469	429	579
	Available water (CCSR)	585	398	330	480
	Crops	See Umetsu et al.	See Umetsu et al.	See Umetsu et al.	See Umetsu et al.
	Groundwater use	No	No	No	150mm (area average)
	Phase IV area	Partially irrigated	Not irrigated	Irrigated	Irrigated

intensive management. In the scenario 2, phase IV would be irrigated with less water supply and water use efficiency would be higher than present because of more investment on water saving techniques. In the scenario 3, water stress is eased by use of groundwater from the deep aquifer. However this scenario has high risk potential for salinity hazard.

- 5) With assumed land use in the LSIP, Irrigation Management Performance Assessment Model (Hoshikawa et al.) and SIFEC (Fujinawa et al.) were run to assess the risks.

3.3 Reflection of scenarios on basin condition

Figure 3, 4 and 5 show reflections of scenarios on the land use in the basin. For the evergreen

conifer forest, which decreases 20% in area (scenario 2 and 3) and for the newly irrigated area that appears in the middle reach (scenario 2 and 3), their spatial distribution was given randomly. Table 2 show the area of each land use in the present condition and in the scenarios.

References

For the reference of the authors below, please refer to individual report of this final report.

Fujinawa et al.

Hoshikawa et al.

Umetsu et al.

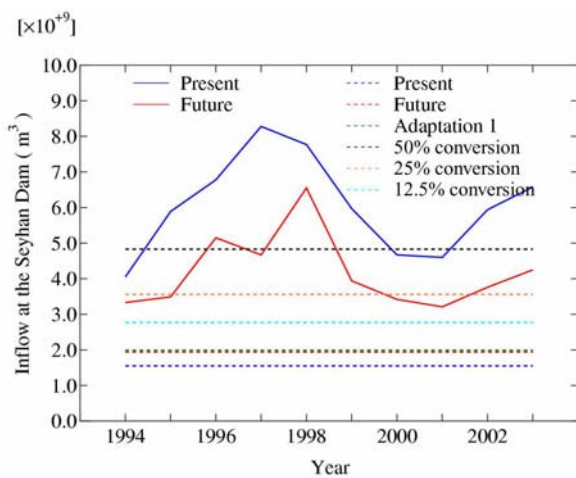


Fig. 1 Comparison of annual total inflow to the Seyhan dam and water demand of different cases

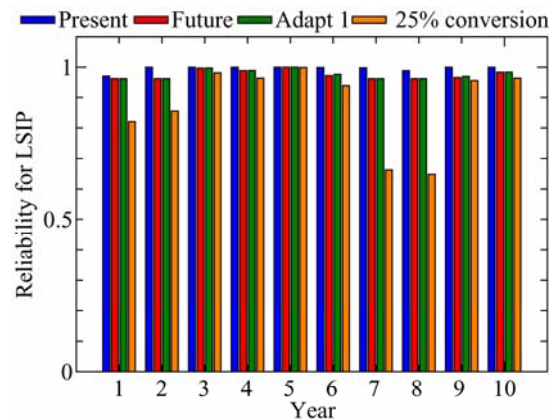


Fig. 2 Reliability of the LSIP with assumed 30,000ha of newly irrigated land in the upstream

Table 2 Area of each land use of the basin condition according to scenarios.

Land use	Present		Scenario 1		Scenario 2/3	
	Km ²	%	Km ²	%	Km ²	%
Water body	191.5	0.87	191.5	0.87	191.5	0.87
Evergreen coniferous forest	4226.4	19.38	4226.4	19.38	3584.2	16.45
Mixed forest	86.8	0.40	86.8	0.40	86.8	0.4
Grassland	6865.9	31.75	11682.2	53.98	7508.1	34.68
Maize	3137.1	14.34	2748.1	12.58	3137.1	14.34
Dry crop land	4816.3	22.23	0.0	0.00	4530.6	20.93
Urban area	45.1	0.21	45.1	0.21	45.1	0.21
Crop/ natural vegetation	0.7	0.00	0.7	0.00	0.7	0
Barren	2171.5	9.98	2560.6	11.74	2171.5	9.98
Citrus	192.3	0.87	192.3	0.87	478.0	2.17

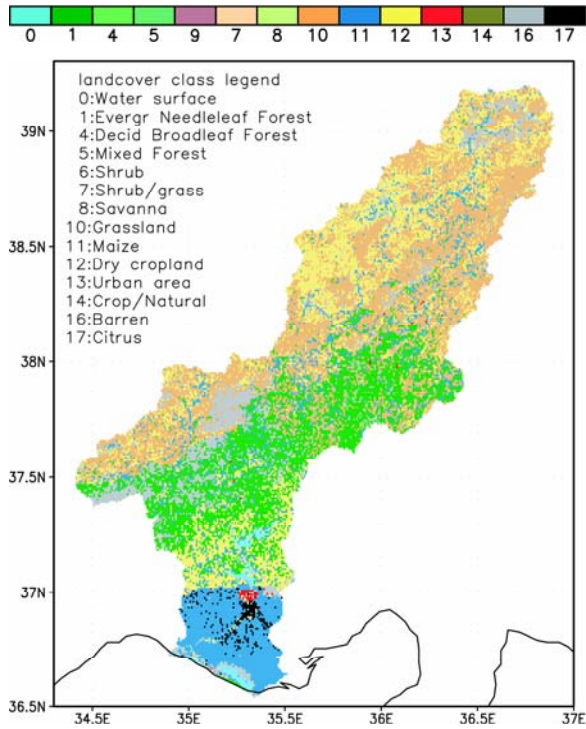


Fig. 3 Present land use.

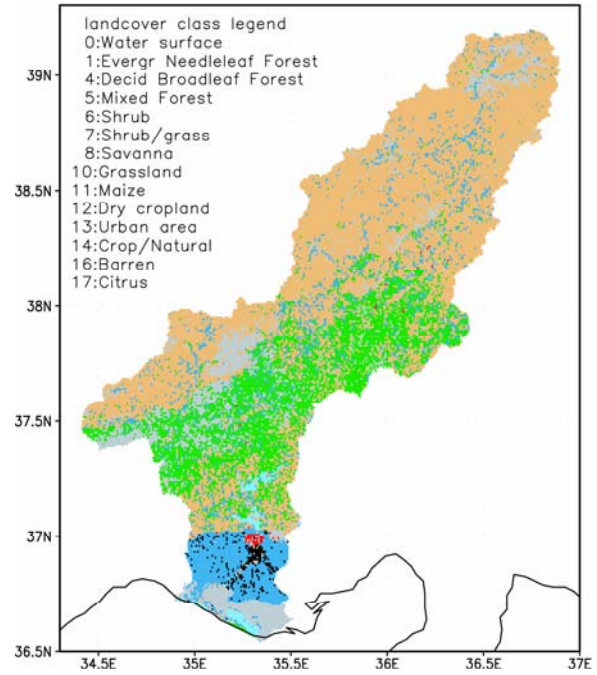


Fig 4 Land use for the scenario 1

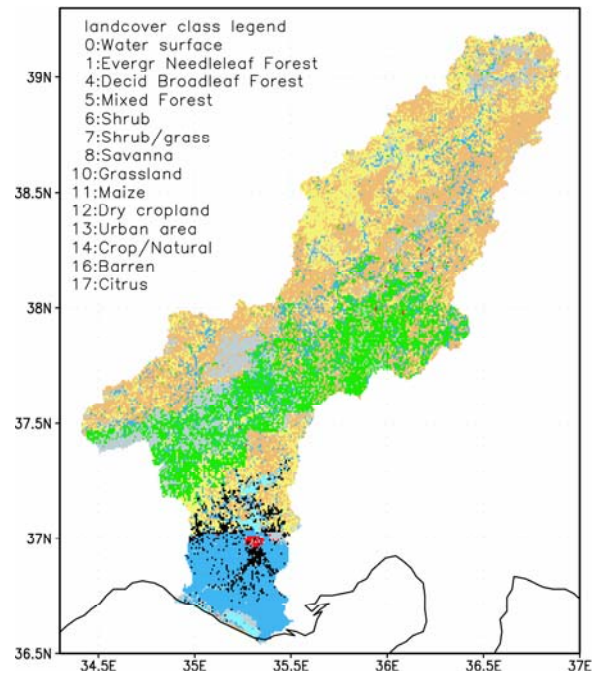


Fig. 5 Land use for the scenario 2 and 3.