**Linear and Non-linear Models and Applications**

**of Arrow-Debreu Shadow Price of Water Resources**

The freshwater resource is the basis of the natural resources and the control element in the development of ecological environment. Meanwhile, it is strategic economic resource as well. Furthermore it is the organic component of the comprehensive national strength. United Nations《The comprehensive evaluation report of the global water resource》declaims: the water problem will restrict the development of the global economics and sociality in the 21 century. What’s more, it will lead to the conflicts between countries. The discussion of the national strategies and relatively scientific problems of the water resource in 21 century is one of the important topics of the issues among the governments in the world. Chinese Ministry of Water Resources shows that the water resource per capital of China is one fourth of the World level of water resource per capital. China is lack of water on average, amount to 50 billion cubic meter. Moreover, the water resource distribution is unbalance on nation wise. The water shortage of North of China is seriously. The Huaihe River Basin and its northern area occupy 63.5% of the national land area, while their water resource account for 19% of that of nation. In the megacity, the water per capital is insufficiency, lower than 200 cubic meter in Beijing, and Tianjing, and 145 cubic meter in Shanghai, far lower than the extreme water shortage warning line--500 cubic meter at international standard. To compensate the water gap of North area, China construct the South-to-North Water Diversion Project. How will we make a useful policy and target for water use efficiently.

Within an environment input-output system and a computable general equilibrium model, a new consumption turnpike is developed with the aim of maximizing accumulated consumptions under water resource constraints; its solution demands dynamic programming resolved by reverse algorithm. Considering technology advance (i.e. the input-output and capital coefficients) and ecological compensation, a turnpike gives effective economy performance on aspect of structural reconfiguration in production and investment. A novel multi-regional model could be applied to look at water used for production and consumption within an area, and to estimate how much water is used local, regionally, nationally and internationally as a result of an areas production. This would be useful for informing policy and targets on water use. Via a CGE model, the water and water resource embodied in China’s interregional trade and its export to European countries (i.e., UK) are calculated, thus the water usage saving and water resource management can be evaluated through the embodied water resource in provincial trade and international trade. In addition, CGE model analyzes the effect of water resource management, ecological compensation or other policy. China’s economy can effective grow if economy restructuring through increasing in the share of the selected high technology industries without panel manufacture growth, annual increase in the consumption by reasonable percentage than actual economy performance. The obligation can be determined more fairly and effectively after evaluate the potential of saving water usage, and the embodied both in consumption and production, as well good policy can be present after the simulation of effect of water resource management on consumer and producer.

Table1.1 Shanghai Water Resource Input-Output Table

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Output  Input/Assets | | | | | | | Intermediate usage | | | | | | | | Final demand | | | Total output | |
| Non-water resource sectors | Water resource sectors | | | | Intermediate usage in total | | |
| Tap Water Production and Supplying | Other water supplying and services | | sewage treatment and reclaimed water [reuse](http://www.baidu.com/link?url=WNnXXaZCfMhTSwRFB7MS-MCrrxIjxfZwY_9C3DeMZZ_NzzMKA3W_sADhhg6TA__PGY-kvX6e4zsnL29PLxVD_I_V_-otFRleaVeqWFN3Spq) |
| 1,2 …,43 | 44,45,46 | | | |
| Intermediate input | | Non-water resource sectors | | | 1.agriculture  2.Coal Mining  ┆  43.Administration and other organization | | Xij | Tij | | | |  | | | Yi | | | Xi | |
| water resource sectors | | value | 44.Tap Water Production and Supplying  45.Other water supplying and services  46.sewage treatment and reclaimed | | Xij | Tij | | | |  | | | Y | | | X | |
| volumne | Allocation water usage | 44.Tap Water Production and Supplying  45.Other water supplying and services  46.sewage treatment and reclaimed  In total |  |  | |  | | |  | | |  | | |
| Self-usage water | |  |  | |  | | |  | | |  | | |
| Water usage in total | |  |  | |  | | |  | | |  | | |
| Intermediate input in total | | | | |  |  | | |  | | |  | | |  | | |
| Primary input | | | | | | Vj | Vj | | |  | | |  | | |  | | |
| Total input | | | | | | Xj | Xj | | |  | | |  | | |  | | |
| Asset | | Capital | | | | Lj | Lj | | |  | | |  | | |  | | |
| Fixed capital | | | | Dj | Dj | | |  | | |  | | |  | | |
| Circulating capital | | | |  |  | | |  | | |  | | |  | | |