

Interim Report of 2003 on

Population Changes and Land Degradation in Xinjiang, China

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In the second year of the project, the research team has made important progress on data collection and processing, theoretical understandings, model construction, and research result reporting.

1. Based on data collection and organization in 2002, we identified the gap of ground socio-economic, demographic data needed for research. The research team invested continuous efforts into data collection and databank construction through fieldwork and data input and organization.
 - In early April of 2003, the research team conducted the second round of fieldwork to meet the data gap. Along the main stream of Tarim River, our researchers investigated all the counties, and the corps of the Xinjiang Production and Construction Troops in the upper, middle and lower reaches. Besides collecting more socio-economic and demographic data, we gained further understandings on the land-water-population interactions in the different parts of the river basin. In particular, we realized that land degradation in the down stream of the Tarim River Basin is critically affected by population growth and water consumption in the tributaries above the upper reaches.
 - In order to systematically study the relationships between population and land degradation of the whole Tarim River Basin, we decided to extend our research sites beyond the main stream and cover the areas of three tributary rivers. The research team took another trip and conducted investigations in Hotian and Kashi prefectures, and collected the data needed.
 - A primary databank has been constructed to contain time series data of 1950-2001 on socio-economic, demographic, geographic indicators for Xinjiang at autonomous regional level, for Bayingguoneng and Aksu at prefecture level, for Division 1 and Division 2 of the Xinjiang Production and Construction Troops at division level, for the counties of Bayingguoneng Prefecture and Aksu Prefecture at county level, for the townships of Yuli County at township level, and for the corps of Division 2 at corps level. A more complete databank is expected to be finalized next April.
2. To measure the situation of land degradation,
 - We obtained a 1:500,000 land use and land cover GIS map in 2000 for Xinjiang Autonomous Region. Seventeen categories of land use and land

cover are identified, providing information on land degradation for each county of Xinjiang.

- Using 1:100,000 topographic maps from aerial photogrammetrical surveys, the research team obtained data on the land use and land cover situation in 1958-1959 for Yuli County in the middle and lower streams of the Tarim River Basin, by scanning, digitizing, and extracting information from the more than 40 large size maps.
 - Exploiting ETM and TM landsat images, we obtained cross-sectional information of 1999 and 1987 on land use and land cover changes for Yuli County. Using GIS technology, the changes in the land degradation of Yuli County in the two time points of 1959 and 1999 were compared.
 - We have already obtained 1973 and 1977 MSS landsat remotely sensed data for Yuli County, and will be analyzing the changes in land degradation in the two time points of this county. By the end of next April, five time points (1958, 1973, 1977, 1987, and 1999) of data on LUCC will eventually be obtained to quantify the evolutionary process of land degradation in Yuli County.
 - Basing on fieldwork and data analysis experience, the research team designed a detailed plan of the methods and steps for land sampling in the downstream of Tarim River Basin. From the end of September of 2003, the group of land analysis started land sampling and is still working on the research site. In about two weeks, approximately 200 land samples will be collected and taken to the lab for analysis at Peking University. The land quality and the degrees of degradation of each land categories will be carefully studied based on the lab analysis of the structural and elemental composition of the land. Accordingly, an index of fragility and degradation by land category will be constructed. This type of information will be used to estimate and compare the situation and potential for land degradation in the past years of 1959, 1973, 1977, 1987 and 1999 for Yuli County and 2000 for Xinjiang as a whole.
3. In early September of 2003, the research project held a working meeting in Xinjiang University. During the one-week long seminar, the four groups of the research team reported their research results, exchanged ideas and perspectives from different disciplines and research fields. Basing on the intensive discussion and cooperative work, we discussed the progress, problems and gaps, integrated the gains from different groups under the general conceptual framework of the whole project, and drew up plans for the next year. More specifically, we intend to organize an international meeting on "Population and land use and land cover changes in ecologically-fragile zones" in late August, in Xinjiang.
 4. Basing on the updated information and analysis, we have made progress in constructing the system dynamic model through which we will study the interactions between population changes (particular migration changes) and land degradation. We have already built the draft of the system dynamic model for Tarim River Basin. Given the critical role of water resources in the arid area, this model links the subsystems of the upper, middle and lower streams of the Tarim River Basin with water consumption. In the meantime, a simplified system

- dynamic model is constructed to simulate the population-land use for the whole of the Xinjiang Region.
5. Based on the historical study of Tarim River Basin and other river basins of the Xinjiang Region, we tentatively proposed the assumption of a historical population-water-land relationship in river basins of arid areas: (1) Population increase was through migration and natural growth, and expansion of human settlement always occurred first in the alluvium downstream in the river basin; (2) Population pressure and saturation of land reclamation limited the inflow of migration to and ignited out-migration in the downstream; (3) Moreover, the advancement of cultivated and hydrological technology enabled the construction of man-made oases and induced population migration into the upper reaches of the river. (4) Increase in population and cultivated land in the upper reaches increasingly consumed more water and reduced the volume and quality of water for the downstream, which degraded ecological conditions and worsened living conditions for people in the downstream reaches. (5) When water shortage and land degradation in the downstream reached critical degrees, abandonment of cultivated land and human settlements occurred and might culminate in the destruction of the whole human civilization in the downstream. (6) Population dynamics, water consumption and land use changes in a river basin of arid areas could be a continuous process of population migration upward, the shortening of the river length, and desertification in the lower streams. This type of historical population-water-land interactions could also be explained and analyzed under the conceptual framework of environmental externality and the tragedy of the commons.
 6. Another assumption we have tentatively made is to explain the migrants' behaviour and land degradation in the arid area. We may categorise the total land area into three settings: the human setting (cultivated land and human settlements), transitional setting (natural and usable land), and desert (or unusable land). Human (migrant) intervention historically always begins in the transitional setting and transforms the natural and usable land into human setting. Water shortage and reduction of land fertility caused abandonment of cultivated land and human settlement. Abandoned human settings usually could only be changed into desert, given the destruction of protective layers of natural land by human intervention. Therefore, the vicious interaction between population and land is the process of humans transforming natural land into human setting, and abandoning human setting into desert. Accordingly, we usually observe the increase of human settings and desert, and the decline of transitional settings, although other factors (e.g. geographic and climate changes) may induce the desertification of natural land without human intervention.
 7. On the basis of our research, one paper was presented at the Annual Meeting of the Population Association of America on May 2, 2003; two papers ("Assessment model and its application on the impact of population change on ecological environment in the arid area" and "Review on the theories and methods of study in population and environment interactions") were published in the *Chinese Journal of Population, Resources and Environment*; two papers ("Review on the study of land degradation" and "Changes of land use and land degradation in Yuli

County”) were submitted to other Chinese journals; one paper “Water resources, land exploration and population health in arid area - The case of Tarim River Basin in Xinjiang of China” was submitted to the 2004 Annual Meeting of the Population Association of America.

8. The project website was constructed and updated for the exchange of ideas and research findings between the research team members and scholars in the field.