Doing Well the Work of Soil and Water Conservation to Serve Rural Economy in Mountain Area —A Case Study in Qianlabagou Small Watershed

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Abstract: Huairou is a mountainous county, where the area of hilly land accounts for 88.99% of the total area. The mountain area is the main region where soil and water loss appears and the economy is relatively underdeveloped. Controlling the water and soil loss to convert local people's poverty into richness is mayor factor to improve the economic development of Whole County. In Qianlabagou small watershed, with comprehensive harness, farmer's average of income increased by 420 yuan and local economy got prospered, and ecological, economic and social benefits have been gotten apparently. This comprehensive harness model set a reference sample for the mountain's development of economy in Huairou even Beijing.

Keywords: soil and water conservation, serve, rural economy, huairou

Huairou is a typical mountainous county where the area of hilly land accounts for 88.99 percent of the total area.The mountain area is the main region where soil and water loss appears and the economy is relatively underdeveloped.Controlling the water and soil loss to lonvert local people's poverty into richness is major factor to improve the economic development of whole county.In 1997 Qianlabagou small watershed stared comprehensive harness when Beijing water source protection and debris flow control engineering began because of the loan which Asica Development Band supplied.

1   The project area situation

1.1   Natural condition

Qianlabagou small watershed lying lookm away the north of Huairou county is the second distributary of BaiHe river system of Miyun Reservoir.The whole watershed areas are 55.085km^2.The features of watershed is high mountain deep valley steer slope thin earth and very heavy soul loss. It is also easy to cause the debris flow which lots of sediment are flowed into MiYun Reservoir.

The watershed belongs to medium and high area It has high mountain and steer slope and complex topography. The gully density of watershed is 4.1km • km^2. The elevation is between 600 meter and 1652meter. The terrain is high in the west but is low in the east so the water converge.Tang River in the Labagou from west to esat.

The watershed lies in the north of Great wall Average temperature is about 9℃ and average preupitation is 450mm–500mm. But the time of rainfall isn't even. Generally the rainfall of between June and August accounts for 70 percent of total preupitation. The area is major northen windy. It has too much wind and large velocity,meanwhile, the matural catastrophe is frequent.

The plant cover of watershed is very plentiful. North of a hill mainly have *East Liaoning oak Chinese pine Linden ,Beijing Chinese ash* south of a hill mainly have *Chinese Arborvitae Ansu Apricot chaste Tree Mongolian oak e*tc. The earth materials of watershed are stony rock and calcium rock. The soil are mainly clay leached drab soil hilly drab soil carbonate drab soil. The depth of earth are between 30 meter and 50 meter.

1.2 Social economic condition

In watershed there are four cun 392 household 1,463 people. Average agricultural land is 1.35 mu. The labour are 513 people. In 1997 the total value of watershed is 2981 thousand yuan. Average income is less 2000 yuan. The economy was relatively underdeveloped and the harness was difficult.

1.3 Soil loss

The watershed has 29.65km^2 the area of soil loss. Among them the light soil loss area is 15.625km^2 and the medium is 13.25km^2 and the heavy is 0.775km^2. The soil erosion modulus is 1,480t/(km^2 • a). The main way of soil loss is surface erosion and gully erosion. The effect of human action and water erosion caused the soil loss.

2 Instructive idea

In several years many engineer and technician through the investigation and study from the reality of project area based on the instructive idea of "improve local ecological environment enrich local farmers,rebuild beautiful mountains and rivers" and on the objection of "purify water quality,control soil loss,accelerate the cohesive development of local society local economy and local ecology" and on the adjustment of production structure insisted on the principle of "the priority of water and soil conservation the prime science and technology the first value the combination of control with development and the combination of harness with management". They completed the united program of mountain, water, forest land and road and completed comprehensive harness,meanwhile, they developed the geographic master of closing capital and developed diverse management and green food.

3 Small watershed

3.1 Small watershed system diagnosis

As well known small watershed is an objective entity which consists of natural economic and social enviormnent and is also a system of multi-layor,multi-factor, multi-disturbance and multi-variation including many natural economic social factors. On the base of related tree-type method of system engineering, we set up the estimated standard of each factor of system. After the specialist estimated and studied the watershed land property land product potent industrial structure human resource water resource social environment and climate resource we established 18 main factors which influent economic development such as poor ecologic environment, low produce level and cultural performance and blockage information. Then we set up the related graph and related matrix R. For the influence between factors. We used four categories as fouows. intense influence ①average influence ②low influence ③subtle influence ④and no influence and established influence coefficient matrix A.After matrix A and R. we used BS and gain the layor sinceture of affecting the factor of system development. Finally we draw each influence factor's influence terntory and influence intensity.

Influence territory = ΣM_a（ij）   Influence intensity=ΣM_a（ij）$\times M_a$（ij）
$i \varepsilon s$ $i \varepsilon s$
$i \neq j$ $i \neq j$

Among M is the delivery bag of R, M_a s the a luttiry-off matrix of M.

We draw the conclusion from the Qianlabagou small waterside system diagnosis. The influence territory of soil loss is 23 and the influence intensity is 100. The influence territory of national factors of land utility structure is 20 and the influence intensity is 95.24.Namely the influential scope of two factors are most large and the influence are maximun. So if we would solve the problem of watershed we must begin to solve the two factors firstly.

3.2 Small watershed ecological economic system model program

The development and improvement of small watershed is the result of all economic action ecological environment social action and scientific action is also a multi-objection dynamic system. Using system dynamics method to simulate dynamically we draw the system opening model as follows:

$$S_D = \int_P^u (\zeta, R)$$

Among P is value objection collection D is effectional objection collection ζ is element collection creating system. R is all the relation over ζ.

Base on the diverse schence of simulation the result of system diagnosis the investigation using "3S" technology for Qianlabagou small watershed and the character of deep hilly Land among lots of objections we totally estimate we completed feasible research and estimated imformation feedback. Then we choose the better as feasible scheme. As follows we have three objection as the optimum expected objection of watershed system construction.

(1) Economic development objection－economic value objection-close maximum

(2) Ecological enviomment objection –amount of soil loss objection-close minimum

(3) Capital using objection－water and soil conservation investment objection-close minimum.

According to this three objections we used multi－objection making-pllicy principle and method of system engineering. using grey theory we established related multi-objection scheme (program) mathematic model regarding the natural. social economic resource as vimicted condition

(VP) $V_{\min} [f_1(x) \cdots f_p(x)]^T$ $g_i(x) \geqslant 0$ $i=1,2,\cdots,m$

Here, $X=[x_1 x_2 \cdots x]^T$ is a vector namely is the variation of scheme $V_{\min}$ means P objection calculated minimum which distinguished the minimum of single objection $[f_1(x) \cdots f_p(x)]^T$ is P objection function and $g_i(x) \geqslant 0$ is M limited lomditions.

Its objection classified two categaries. One require that objection function is minimal and it is more better such as soil loss investment cost etc. The other require objection function is maximal and it is more better such as economic benefit yiele imcome etc. so if using the method of time and divided to calculate and supposed m minimal objection and P-M maximal objection we raised a new function.

$\text{Min}U（x）= f_1(x) \cdot f_2(x) \cdots f_m(x)/f_{m+1}(x) \cdots f_p(x) \cdots x \in R$

We calculate the optimum answers of new function which coincide with the needs of ecological objection economic objection and investmented objection and made system function reach the optimum program to act as making－policy fundation. Finally we gain the best model of Qianlabagou small watershed ecological economy systerm construction.

4 Achievement

After establish the best model objection we adjust the direction of land utility. And control soil loss.we combined harness and utility with protection and achieved great success.

4.1 Harness achievement

Till 2001 year the Qianlabagou watershed has completed 29km^2 harness areas. Its harness dagree reached 97.8 percent. It had developed added-up 50hm^2. Forest for erosion control and 20hm^2 economic forest. It closed off afforested hills 2,860hm^2. It had built 200 check dam and 2,140 meter long protection dam and 10 check dam for holding sediment. It had rebuilt 1,000 meter long small ditch. It completed 20hm^2 fruit tree irrigation land and 100hm^2 protecion trees. It had dug 50hm^2 fish－scale pits and repaired 10km long field road.It changed five regions of barren shaol and plant 680 mu forest land and prepare 800 mu land.

4.2 Achieved benefit

The obvious benefit by harness mainly showed as follows

(1) Econonic benefit

According to statisticthe watershed total value in 2000 was 583.69 thousand yuan which increased more 162.69 thousand yuan than that in 1998. The average yealy production was 4,159 yuan in 2000which increased more 1,367 yuan than that in 1998.The average net income was 3,247 yuan in 2000, which increased more 1,258 yuan than that before harness. The farmer's average income increased 420 yuan only by planting traditional Chinese medicinal materials.
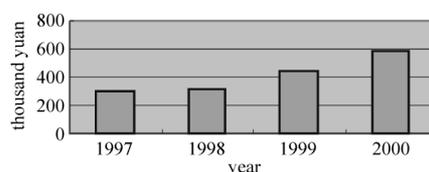

Fig.1   total value of the watershed

(2) Ecological benefit

Through harness the tree and grass vegetation cover percent increase 10 percent. The watershed soil erosion modulus decreased from $1480t/(km^2 \cdot a)$ before harness to $316 t/(km^2 \cdot a)$. Soil loss has controlde basicly and the ecological environment close benefial circle.

(3) Social benefit

The watershed comprehensive harness reduced the pressure of reservoir from sediment and immuned the reservoir source from pollution. The local agricultural product structure was gradually rational and ratio of land utilization efficiency improved evidently. After the harness completed the harness model and way of management of watershed have caused rather radiative benefit in society which the news media of Beijing suburb daily newspaper have reported. Till present the watershed has received hundred of people including major and conuty leader specilost the technician from other county and from other watersheds of Huairou. The experience has introduced 20 places of Baoshansi town Changshaoying town LiuLimiao town of Huairou and other counties. They achoeved better economic benefit and social benefit.

The comprehensive harness made localpeople quickly get rid of poverty and enrich. The people's living changed from simply having adequate food and clothing to being fairly well-off. The economy realized market economy. On the base of comtrol the watershed developed forest husbandry ecomomy forest fruit economy and fruit-agricultural crop economy and open up tourious. The change of enviorn ment improved the capacity of sustainable management and developed other economy.

5   Conduction and ecperience

To assure the problem of canying out projection engineering quality and utility we notice the follow problems in the during of project exertion.

5.1   Principle of suit measures to local conditions

In project area the techndogical measures of design and scheme considered local reality. It made not only scientific and beautiful but also economic and useful. we took different measures according tso different reality.

5.2   Systemtic principle

In project area the measures of scheme noticed cohesion and formed the system which developed the function of each measure and the value of generation. The whole function of each measure reached the best. For example we combined the slop preparation with the collecting rain engineering.

5.3　Beneficial principle

In project area the measures of programs considered the investment effect which assure the quatity of engineering and reduce to put in capital make use of indigenous materials and develop the earth of dam all get from local area.

5.4　Principle of the basis of science and technology

In project area all the programs and measures timely adopied the newest technological achievement about agriculture forest and fruit which ensure that the comprehensive harness keep high starting point high standard high quality and high benefit. For example *Rs* and *GPS* respectively investigate the soil loss area and soil utility situation. And the use of sprinkler irrigation.

6　Conclusion and discussion

In sum the success of Qianlabagou small watershed harness model inclued several aspects:

(1) It has successfully seeked ecological economy construction of hilly area water and soil conservation small watershed comprehensive harness to serve for hilly area rural economic development. It solved the difficult problem which soil loss limited economic development and created feasible experience.

(2) Under the condition of great market economy it speed up the dynamics of changing the traditional agrilultural economy into the ecological and open market economy. It supplied the experience for the different type of hilly area soil conservation comprehensive harness and for sustainable development study.

(3) During the course of program and exertion of comprehensive harness we used the advanced technology and theory such as system engineering multi-objection policy-making ecology "3S"technology and the most newly agricutural forest fruit technological achievement. It assure that the harness keep high starting point high standard high quality high benefit.

(4) The harness of watershed combined the macro － control with micro － adjustment combine hard wear measures with soft wear management combine modern the macro － control with micro-adjustment combine hard wear measures with soft wear management combine modern theory with reality and useful technology. Changing sigle value into comprehensive value greatly increased the opening up intensive degree compound degree and improved the watershed sustainable management capacity.

The shortage of harness is that all the engineering program only emphasize the effect of holding water and sediment but meqlect to protect natural cleanness and maintain the coincidence with human and water and enviornment. we will improve this problem in the future.

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