Discussion on the Coordinative Functions of Seabuckthorn in the Sustainable Use of Water and Land Resources in Soft Rock Area

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Abstract: Based on the sediment retention experimental results by seabuckthorn "flexible dam" at the gully head area in soft rock region, gully channel comprehensive control model and agricultural planting and management model of seabuckthorn, the paper analyzed the dominant coordinative function of seabuckthorn in sustainable soil and water use in the region and the coordinative relationship. The also presented a diagram of harmony relation between human beings and environment coordinated by seabuckthorn "flexible dam" system. It proves that the fact of the scientific suggestion of "taking seabuckthorn resource development as a breakout for accelerating treatment on loess plateau" is the all-direction coordinative function by seabuckthorn "flexible dam" system from gully head section. The paper finally pointed out the inevitable result of sustainable development.

1 Cause of issues

The soft rock region with the area of 11.7 thousand km^2 locates in the boundary area of Shaanxi and Inner Mongolia where rock is composed of mud rock, sandstone and sand shale, the mountain is bare, slope is steep, flow is torrential. Here is called the most serious soil erosion area in the world. And now here is involved in the poverty and environmental degeneration situation. And this has threatened human being's life and social development. How to change the environment into better cycle is an important problem concerned by governments and scholars. In the course of practice and near ten-year scientific experiment in the area, the authors found: It is Qian Zhengying, the former minister of MWR who found and rescued seabuckthorn if natural power and human activity destroy the ecological environment of loess plateau so that local tree specie of seabuckthorn disappeared. She put forward scientific suggestion of "taking seabuckthorn resource development as a breakout for accelerating treatment on loess plateau" [1]on Nov. 26th of 1985 after investigation and study. This is the first time for seabuckthorn rehabilitation and development in loess plateau. And this is the milestone of artificial seabuckthorn resource construction in loess plateau. For sixteen years, seabuckthorn planting spreads over 19 provinces in northeast China, northwest China, north China and southwest China. It has become the pioneer tree specie for soil erosion prevention and quick ecological recovery. Since the successful experiment of seabuckthorn plantation on steep slope land in the soft rock region [2] , there has had 66.7 thousand ha artificial seabuckthorn forest although serious drought lasted from 1997 to 2001. Drought has caused insect pest and led seabuckthorn death in certain area [3], but this did not affect the soil and water conservation function and its development value. The experimental research of *Plant "flexible dam" in Soft Rock Region* during 1997 and 2001 showed: ① the experimental data proved that the "flexible dam" could hold up big-size sediment from gullies and culled big-size sediment and small size sediment naturally for the first time. Seabuckthorn can grow continuously in high growth speed. The buried seabuckthorn stick can germinate new horizontal roots and new shoots will grow in the horizontal roots so to increase "flexible dam" body; ② The research proved seabuckthorn can become cheap dam materials in the local area and possesses functions of ecological rehabilitation, sediment retention and soil conservation, increasing erosion base-line as well as flow-discharging and flood-spilling; ③ The study presented the sediment retention mechanism of

"flexible dam" system was to corrupt and scatter the strand flow in gullies by branches and twigs so as to reduce stress between flow and bed. This also divided unit-length q and slope ratio J in Y_sqJ unlimitedly so as to make sedimentation in local area. There preliminarily established a theoretical frame. The results above let people found the profound mystery where nobody knew the weapon for sediment retention, sediment culling and flow discharging sought by scholars is the small shrub-seabuckthorn. So far we have sought a method for sediment retention in the area where large amount of sediment produced in gullies and mainly in non-runoff sediment production.

The crux of Yellow River is sediment. The complex problem will become simple while materials for sediment control was sought. The paper also pointed out that the fact of the scientific suggestion mentioned above is the coordinative function of "flexible dam" system for sand, soil and water in branch gullies and the ecological and economic value of seabuckthorn. On the basis of *Comprehensive Soil and Water Conservation Model for Soil Erosion Prevention in Soft Rock Region*[5][6][7] issued by the authors *Agricultural Planting and Management Model of Seabuckthorn Ecology*[3] issued by Zhou Zhangyi, the paper analyzed the dominant position of seabuckthorn "flexible dam" system in fully coordinative function and the principal position in gully head ecological recovery as well as the four aspects of coordinative relationship.

2 Two models

2.1 Model 1

Comprehensive soil and water conservation model for soil erosion prevention in soft rock region, in short, comprehensive gully treatment model.

① Comprehensive gully treatment model.

To arrange flexible dam, warping dam, key dam and mini-reservoir starting from gully head in a small watershed with the area of 20km^2.

② Numerical relation of the model

Model:
$$m = F_d + W_d + K_d + V_d \tag{1}$$

The relation is:

$$V_d = 1 \tag{2}$$

$$K_d = 3V_d \tag{3}$$

$$W_d = 3K_d \tag{4}$$

$$F_d = 9W_d = 27K_d = 81V_d \tag{5}$$

2.2 Model 2

Agricultural planting and management model of seabuckthorn ecology, in short, agricultural planting and management model. The model takes seabuckthorn as a kind of "crop", planting in the first year, harvesting leaves and fruits after 2—3 years, harvesting branches after 7—8 years in bad planting site, cutting trunk for renewing after 15 years.

The two models should be used cooperatedly. The former one established a good foundation for utilizing sediment, soil and water resources, the later one settled a good base for seabuckthorn entering into market as a new kind of "crop". All of these will make a whole foundation for harmonious living between human beings and the outside environment.

3 The relation of soil erosion prevention on the basis of coordinating water and soil in gully channel

(1) To coordinate sediment, soil and water resources. Seabuckthorn "flexible dam" system shows the dualism along flowing direction. The "flexible dam" system by mixing with warping dam, key dam

and mini-reservoir formed the systematic gully engineering works for regulating sand, soil and water. Form formula (5), you can see that quantity of “flexible dam” is as nine times as warping dam and as twenty-seven times as key dam. As a result, there formed artificial seabuckthorn forest in gully head section, artificial wetland in middle section and artificial lake near gully outlet. This can create better soil and water resources in gully channel so as to establish good basis for industrial structure readjustment and agricultural and animal stock development.

(2) To coordinate gully channel and slope land. As long as there are good land and water resources, the relationship between gully channel and slope land will be coordinated so as to promote replacing slope land by planting trees shrubs and grasses and to develop and protect natural grassland on slope land. According to investigation, income from gully land is 3—5 times than that in slope land after gully treatment. In addition, here is available for grasses and shrubs because the area belongs to desert pasture zone. Such as caragana, seabuckthorn and other grasses can be planted on bare soft rock and on soil-covered soft rock. Sandy willow, sand sagebrush and seabuckthorn can be planted on sand-covered soft rock. Therefore, we can select suitable shrubs for planting contour plant hedge[8]. Grasses can be planted between hedges so to prevent sand storm, control desertification and coming into slope land grass ecology.

(3) To coordinate ecology and Economy. After the ordinate and perpendicular regulation, this will settle good base for seabuckthorn planting planning and development. During the 9-year life of seabuckthorn, it can make green products for twenty first century and become the raw material for medicine and health care products. It also can make great economic benefit. So the seabuckthorn industry will be the potential core industry for poverty elimination.

(4) To coordinate Human beings and environment. Through the three kinds of coordinative relation above, there will form a relative balance between ecology and economy. After obtaining economic income, farmers can input again for enlarging production. Thus will come into being stable ecological environment and great economic result. It also ensures the local social demand. It is evaluated that the whole development course will be increasing helicity cycle so as to reach the sustainable development way.

4 Seabuckthorn “flexible dam” will coordinate the relation between human beings and environment

The following diagram shows the relations coordinated by seabuckthorn “flexible dam” in a small watershed with the area of 20km^2. This is a macro-frame diagram. Each aspect contains some sub-systems.

From the diagram, you can see that good cycle will be formed from “flexible dam” coordination to gully sediment, soil and water.

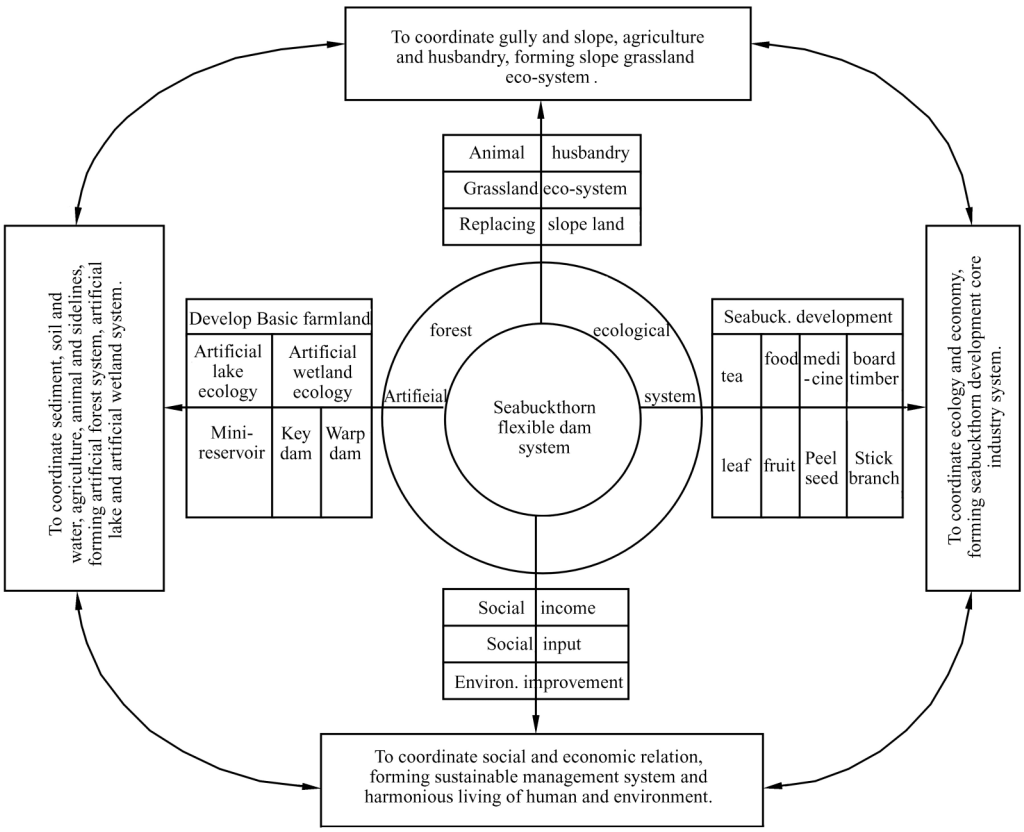
5 Conclusion

(1) Seabuckthorn presents as a kind of structural material in soil and water sustainable use in soft rock region. The integrated collocation of gully treatment techniques does not only prevent soil erosion, but also regulate sediment, soil and water, and reflect the dominant function of sediment retention in gully head section and principal function in local ecological recovery. Therefore it formed the harmonious relations between gully and slopeland, between ecology and economy, between economy and society, between human beings and environment.

(2) The coordinative results formed four artificial ecological systems, a core industry and a sustainable development management system, i.e. gully artificial forest ecological system, artificial wetland system, artificial lake system, slope grassland system, seabuckthorn industry development system and sustainable development and management system.

(3) Artificial seabuckthorn forest ecological system is formed in the gully head section. Basic farmland locates in gully channel. This presents “loess plateau ecological and economic science is on the basis of agri-ecological economy, and by taking forestry ecological economy as a principal unit”[9].

(4) The diagram issued by authors is a macro-frame diagram. Each aspect contains a series of sub-system. The diagram accords with the sustainable development strategic thought in the outline of *Agenda of the Twenty First Century*. It also proved that the fact is the coordinative function by seabuckthorn for the suggestion of "taking seabuckthorn resource development as a breakout for accelerating treatment on loess plateau".



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