

Study on Adaptation to Climate Change of Hani Terraced Fields Complex Ecosystem

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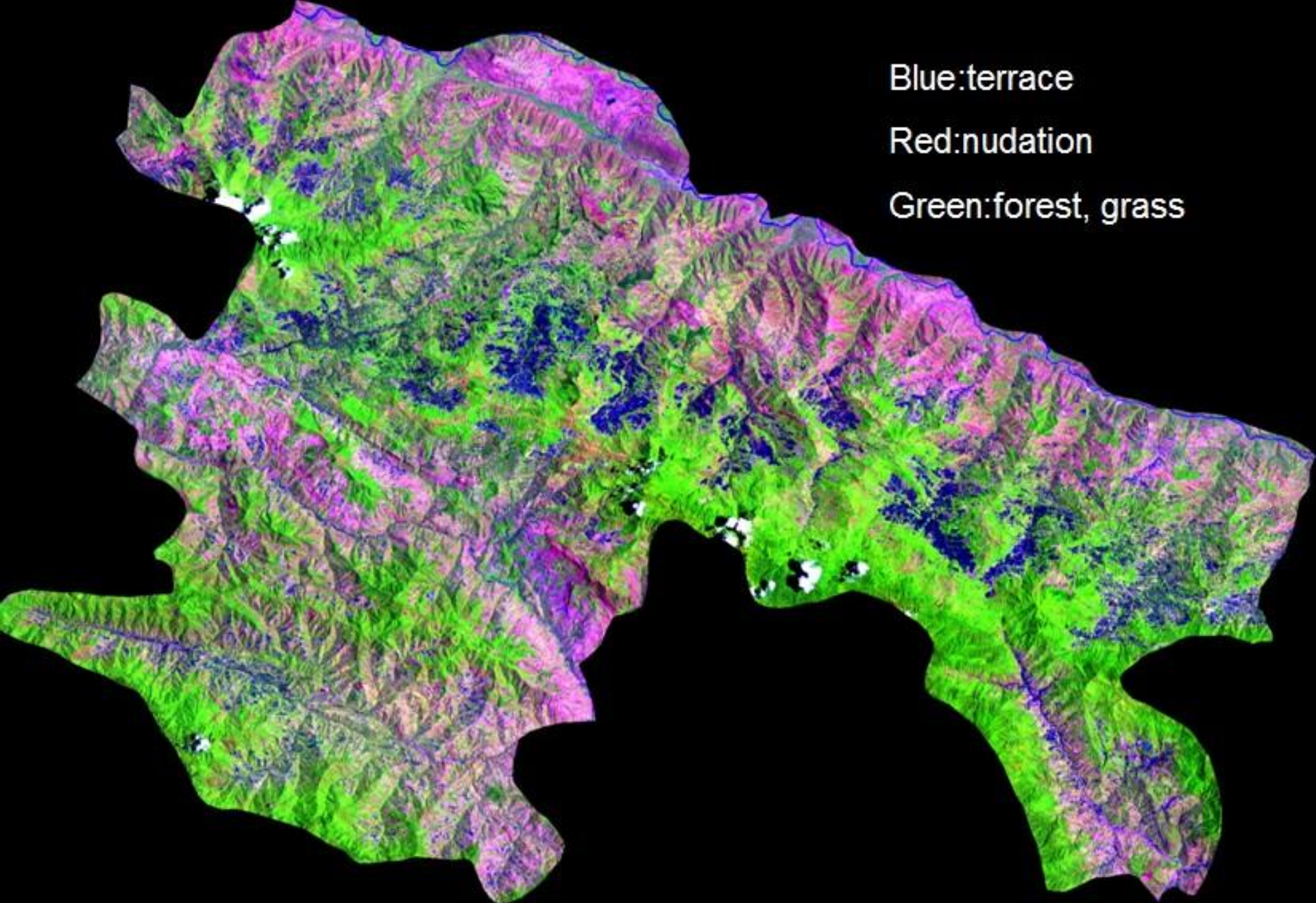
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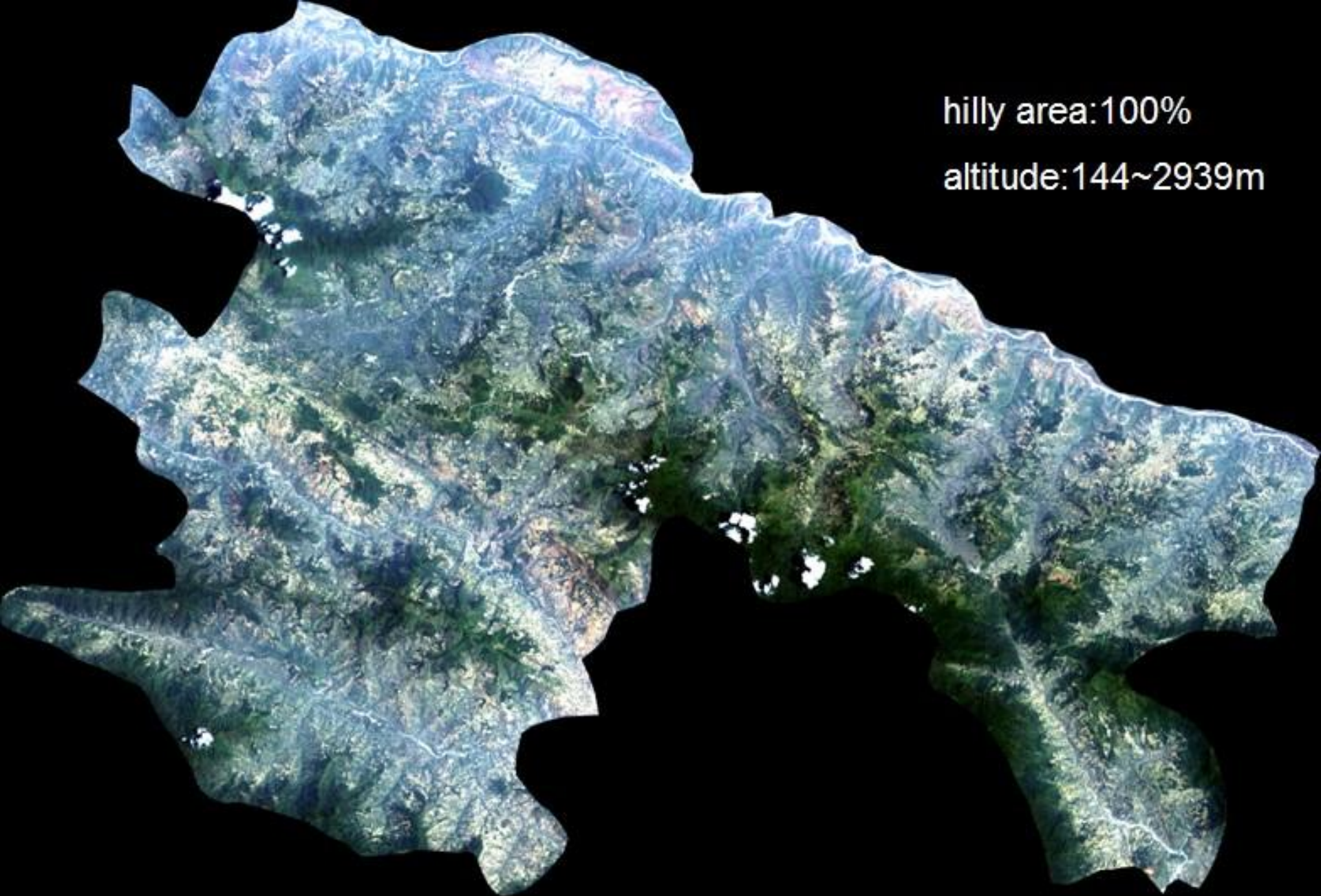
Introduction

- Hani terraced fields mainly distributed in southern part of Yunnan Province, along Ailao Mountain, Yuanjiang River Basin, covered an area of 40,000 ha. It was co-created by native Hani and Yi People as well as other people from various groups, enjoys a history dating back to 1,300 years ago. The terraced paddy fields are built on the slopes with elevation ranges from 144m to 2,000m, with gradient between $15^{\circ} \sim 75^{\circ}$.





distribution of Hani terraced fields (remote sensing image)



hilly area:100%

altitude:144~2939m

remote sensing image of Yuanyang county

Introduction

- An most severest drought during the past 60 years took place in southwest part of China in early 2010, maybe due to the negative affect of climate change. The total amount of precipitation is under 50% of normal year, some region even under 30% or less. Water supply from major rivers decreased 30%-80%. It seriously affected agricultural production of this areas , totally 5.03 million ha, of which 1.12 million ha have no harvest, losing 3.76 billion USD.
- **But, CCTV report that Hani terraced fields only slightly affected by the drought, a significant news.**

Introduction

- **Our investigations showed:**
- Nature and human factors jointly take effects on adaptation to drought disaster of Hani terraced fields complex ecosystem.
- Ecosystem integrity, highly efficient utilization and management of water resources and effective protection and management of forest are the critical factors for Hani terrace to cope with extreme drought.
- Traditional knowledge related to Hani ethnic group played an important role in the process to cope with the extreme drought.

2. Hani Terraced Fields Complex Ecosystem

2.1 Structure and Function of Hani Terraced Paddy Fields Complex Ecosystem

- Hani terrace complex ecosystem has a significant characteristic for its vertical distribution, it formed spatial structure of forest-village-terrace-river orderly distributed along with contour lines, which plays an important role in soil preservation, system stability maintenance .

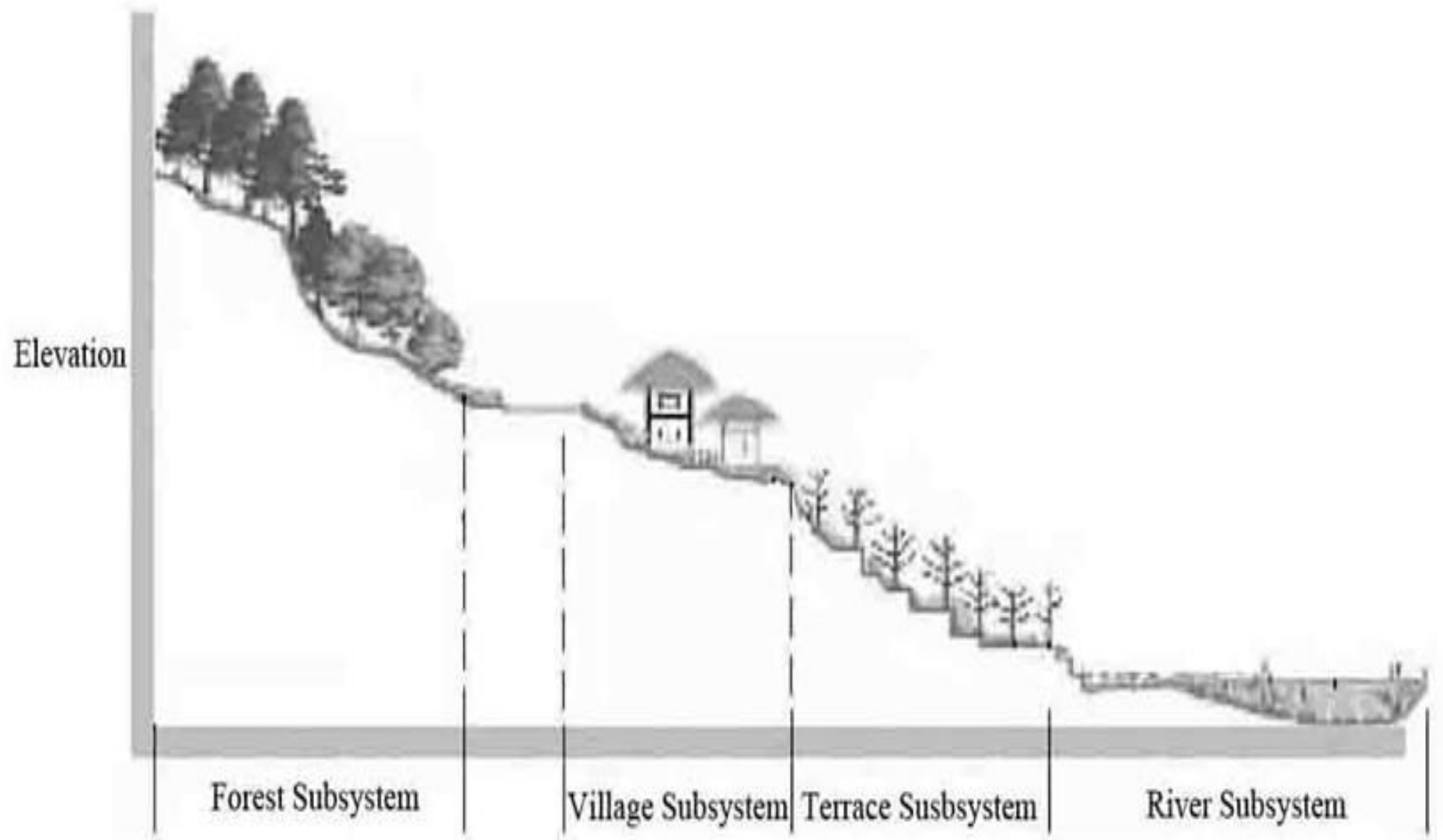


Fig.1. Structure of Hani Terraced Fields Complex Ecosystem

2. Hani Terraced Fields Complex Ecosystem

- Forest eco-subsystem distributed in the highest elevation of the system, it serves as the core of the whole system with functions including rainfall retention, water resource conservation, and soil erosion prevention;
- Village eco-subsystem distributed in mid-slopes of the mountain, it serves as an important control point of water resource allocation via water storage and re-allocation;
- Terraced fields eco-subsystem located in lower mid-slopes of the mountain where water resource can be used for irrigation;
- River eco-subsystem distributed in dry hot valley, it serves as a critical factor of water collection and water resource cycling utilization due to intensive activities of evaporation and transpiration.

2. Hani Terraced Fields Complex Ecosystem

- **2.2 Water Circulation within Hani Terraced Fields Complex Ecosystem**
- Irrigation water sources of Hani terraced fields complex ecosystem mainly composed by surface runoffs and spring water exposed out of precipitation intercepted by forests.
- Water streams flow into terraced fields via villages from upper forests along with irrigation canals and ditches.
- Both upper and lower dikes of terraces have water inlets and outlets, and the excessive water then spill out into lower dikes via conduit automatically during whole year.
- Water finally flows into rivers located in the dry-hot valleys. Water valleys densely scattered with rivers have strong potential of evaporation due to all year around high temperature.
- Continuous misty rainfall occurred when warm air mass out of water vapor evaporation ascend to alpine lower temperature zone. The rainfall can form a myriad of streams and ponds, which will re-moisten the pristine forests.

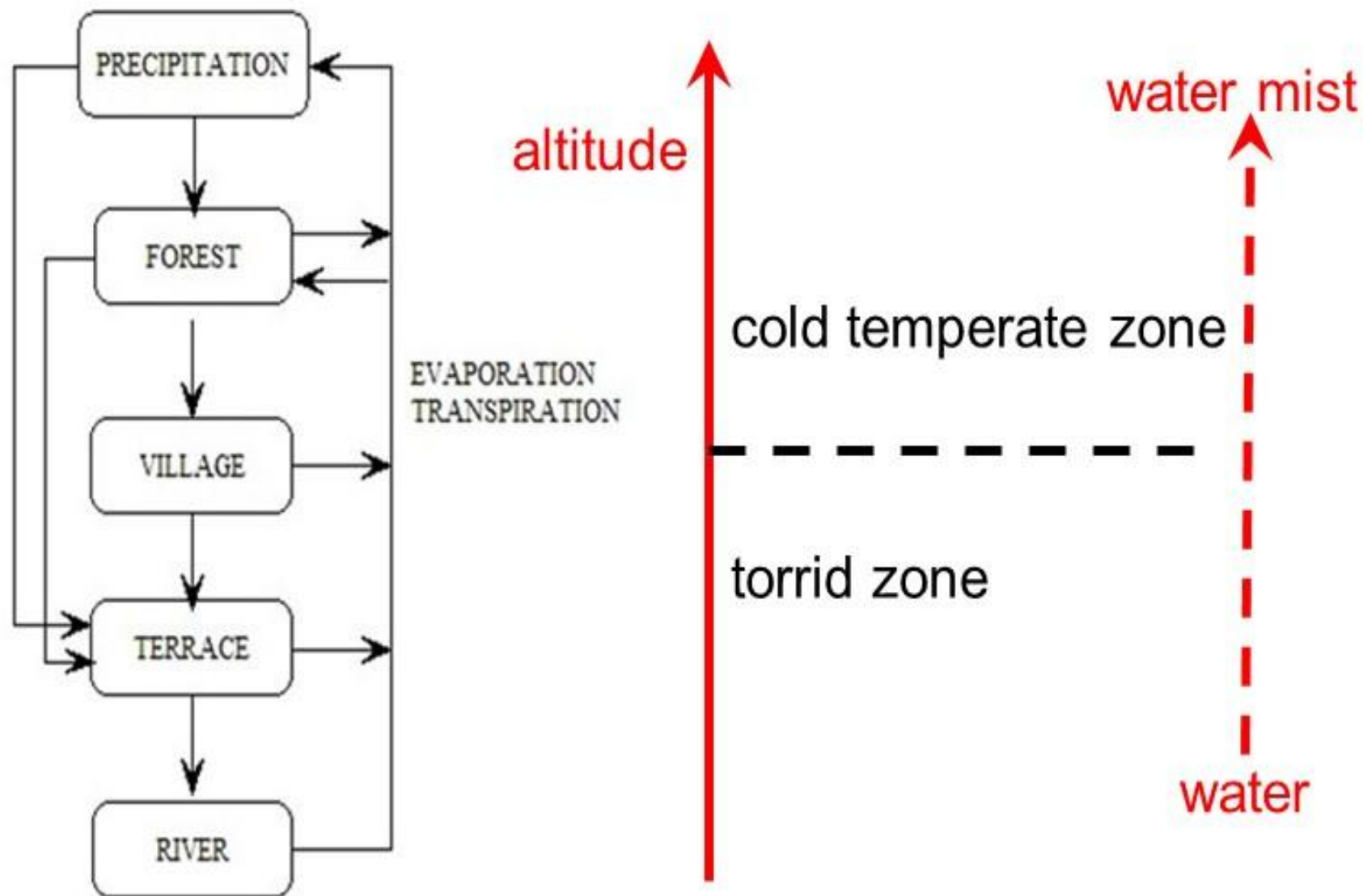


Fig.2. Water Circulation Process of Hani Terraced Fields Complex Ecosystem

2. Hani Terraced Fields Complex Ecosystem

■ 2.3 Interaction within Subsystems

- In the complex system, forest eco-subsystem provides daily life necessities of water, firewood, plant and animal products, timber for housing, etc.
- Terraced fields eco-subsystem provides food such as paddy rice, fishes, shrimps and cress (vegetable), it also serves as the major source of forage for livestock;
- Village eco-subsystem can regulate the whole terraces system by controlling water, input human and animal manures in to the terrace system, provide animal power, other supplemental energy and various technologies to the whole terrace systems;
- Water resources recycling realized in river valley eco-subsystem can provide a stable water supply by water accumulation, evaporation and rainfall again.

3. Highly Efficient Utilization and Management of Water Resource

■ Hani People have abundant practical experiences in water resource management and regulation. These traditional knowledge is mainly embodied as below:

- Villagers' awareness of water resource protection and water respect;
- Control water by construction and management of irrigation canals and ditches;
- Allocate water through notched wood (rock);.

3. Highly Efficient Utilization and Management of Water Resource

- **3.1 Construction and Management of Irrigation Canals and Ditches**
- Hani People developed their own unique irrigation system for centuries by establishing canals and ditches, channeling water accumulated by mountain streams.
- Local government can sponsor materials for ditches building such as cement, conduits, steel bars, etc, and specific villagers are responsible for ditches management, paid either in money or food.
- Overhaul maintenance of irrigation ditches is carried out in every early spring by voluntary labors come from each family.
- Rotation irrigation practice is adopted during dry seasons in order to avoid disputes arising out of water utilization.

3. Highly Efficient Utilization and Management of Water Resource

- **3.2 Notched Wood (Rock) Approach in Water Allocation**
- Water requirement of each terrace is determined through collective negotiation among villages and households based on acreage of irrigated area and amount of water flow from ditches.
- The amount of water divided is measured by a piece of wooden (rock) weir with notched cuts in accordance with water demanded. The wooden weir is placed across the irrigation channel, then water can be automatically channeled into terraced fields successively along ditches in a required proportion amount allocated by the weir.

3. Highly Efficient Utilization and Management of Water Resource

■ 3.3 Awareness of Water Resource Protection

- Hani People for centuries hold feelings in awe and veneration deeply in their heart for waters. Water well is regard as clean and sacred and the source of life and the heart of their village.
- They designate specific person responsible for cleanup and maintenance of water every year. Hani People always pay specialized sacrifice to water by various sacrifice activities every year.
- Hani People like to excavate small trenches for water storage used for irrigation in case of water shortage during dry seasons.
- In addition, family's sewage is used to flowers and trees, or stored in pond for later use as fertilization.

4. Traditional Knowledge for Biodiversity Conservation and Climate Change Adaptation

- **4.1 Effective Preservation and Management of Forest**
- Hani People divided forest into four categories, namely, water source forest, stockade holy forests, landscape forest, firewood forest, etc. the former two kinds of forests are sacred forests protected through religious deification.
- Hani People have a series of village protocols and customary laws or agreements to punish the activities in deforestation of water resource forests and village holy forests.
- Hani People have rich traditional knowledge to nourish and protect the tree species that are native with better capacity to water conservation.

4. Traditional Knowledge for Biodiversity Conservation and Climate Change Adaptation

- **4.2 Eco-ethics of Harmonious Combination between Human and Nature**
- The philosophy of “Harmony between the Nature and Human” with emphasizes on nature-oriented way of development, rather than human-centered mentality.
- The cardinal principle of Hani People in dealing with the relationship between human being and environment is natural rhythm that has been deemed as God’s will. It is helpful for Hani people to sustain the harmonious relation between humanity and nature.

4. Traditional Knowledge for Biodiversity Conservation and Climate Change Adaptation

■ 4.3 Holy Forest Culture

- Hani people have long ago realized the importance of forest in their farming practices, holy forest culture thus developed with adoration, worship and protection. There are 431 plots of holy forests in Yuanyang county according to incomplete statistics.
- Hani people also listed a “genealogical” for various plants and trees in particular along Ailao Mountain. They tend to get species deified by claiming those were planted by gods for protection reason.
- Moreover, Hani People relate forest with mountains, valleys, all things on earth, farming seasons, water used for terraced fields, embody this culture through legends, stories, poetry, folk songs, proverbs and nursery rhymes, so that the whole Hani ethnic group hold strong devout and respect feeling towards surrounding forests.

4. Traditional Knowledge for Biodiversity Conservation and Climate Change Adaptation

- 4.4 Technologies of Terraced Paddy Fields Farming
- Fertilization by running water;
- Fish culture in paddy fields;
- Abundant genetic diversity for traditional varieties of paddy rice, adaptable to high altitude terrace.

4. Traditional Knowledge for Biodiversity Conservation and Climate Change Adaptation

■ 4.5 Customary Laws

- A series of customary laws have been gradually instilled into the people of Hani Ethnic group through long-term living and production practices. The punishment is usually economic, obeyed by customary laws or village protocols. The most serious punishment is to banish offender out of the family or the village.
- The customary laws of Hani almost covers all the daily life of Hani People. Particularly, some articles are elaborated specially for protection of biological resources and sustainable development, such as holy forest.

4. Traditional Knowledge for Biodiversity Conservation and Climate Change Adaptation

■ 4.6 Festivals and Sacrifice Rituals

- A whole package of festivals and sacrifice rituals of Hani People is closely combined with rice terraces. For instance, “Angmatu” is celebrated in a collective sacrifice for village God, village holy forest, and water God, etc.
- Family sacrifice activities are to respect terraced fields, grain God and barns. The principal part of Hani festivals and sacrifice rituals are for nature including forest and water. Some sacrifice activities to respect water god, like sacrifice for crabs, clams, gutter and ditch reveal.
- The all sacrifice activities can reflect Hani people’s high respect of water and forestry, i.e. the ideas for natural conservation.

5. Mechanism of Hani Terraced Fields Complex Ecosystem Adapts to Climate Change

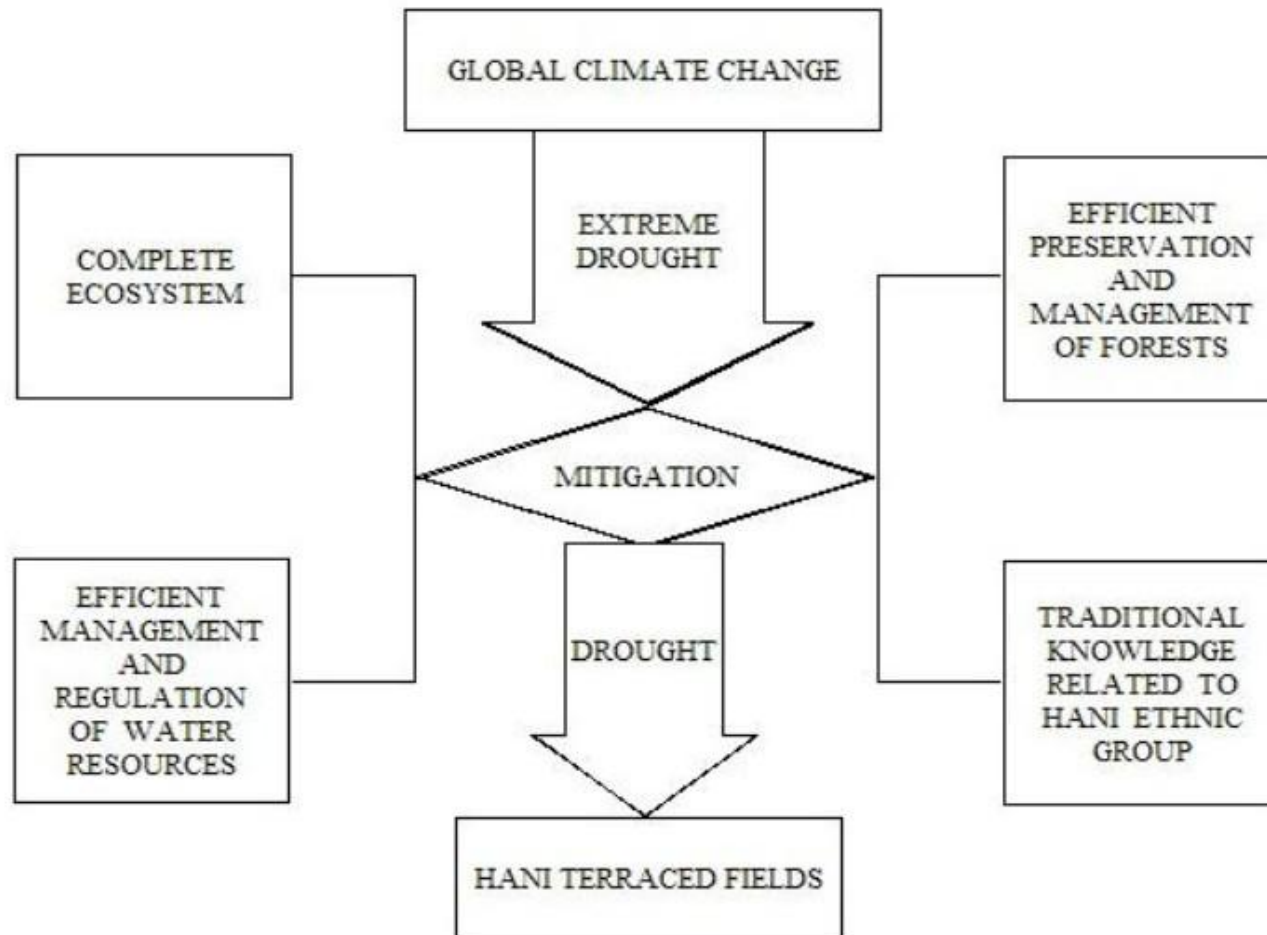


Fig 4 Mechanism of Hani Terraced Fields Complex Ecosystem Adaptation to Climate Change

6. Conclusion

- Hani terraced fields complex ecosystem is an efficient way to water utilization, forest conservation and village management. Their experience of integrated ecosystem management can be popularized to cope with climate change.
- Traditional knowledge has played a particular role in conservation and management of water and forests. It is a practical approach to adapt extremely climate and reduce disaster damage.