

Research on Resilience of Agricultural Drought from Temporal Dimension: Case Study of Large-scale Drought in Northern China since Republic of China

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1. Introduction

- ❖ **Research on resilience of agricultural drought is a popular topic in the natural hazards or disaster field.**
- ❖ **Hazard-affected bodies (HAB) and Government Action (GA) change over time to cause positive or negative effect on resilience.**
- ❖ **Resilience process (RP) has obvious differences in different phases to impact the establishment of the index systems of resilience (ISR) .**
- ❖ **Different periods should built different index systems for resilience assessment.**



Introduction

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1. Victims were at their last gasp in 1920



3. Yellow River was first break down in 1972



5. Dead rape because of the drought in 2009



2. Dead victims because of the drought in 1920



4. Construct irrigation in 1970s



6. Harvest after the drought in 2009

Time Scale

A

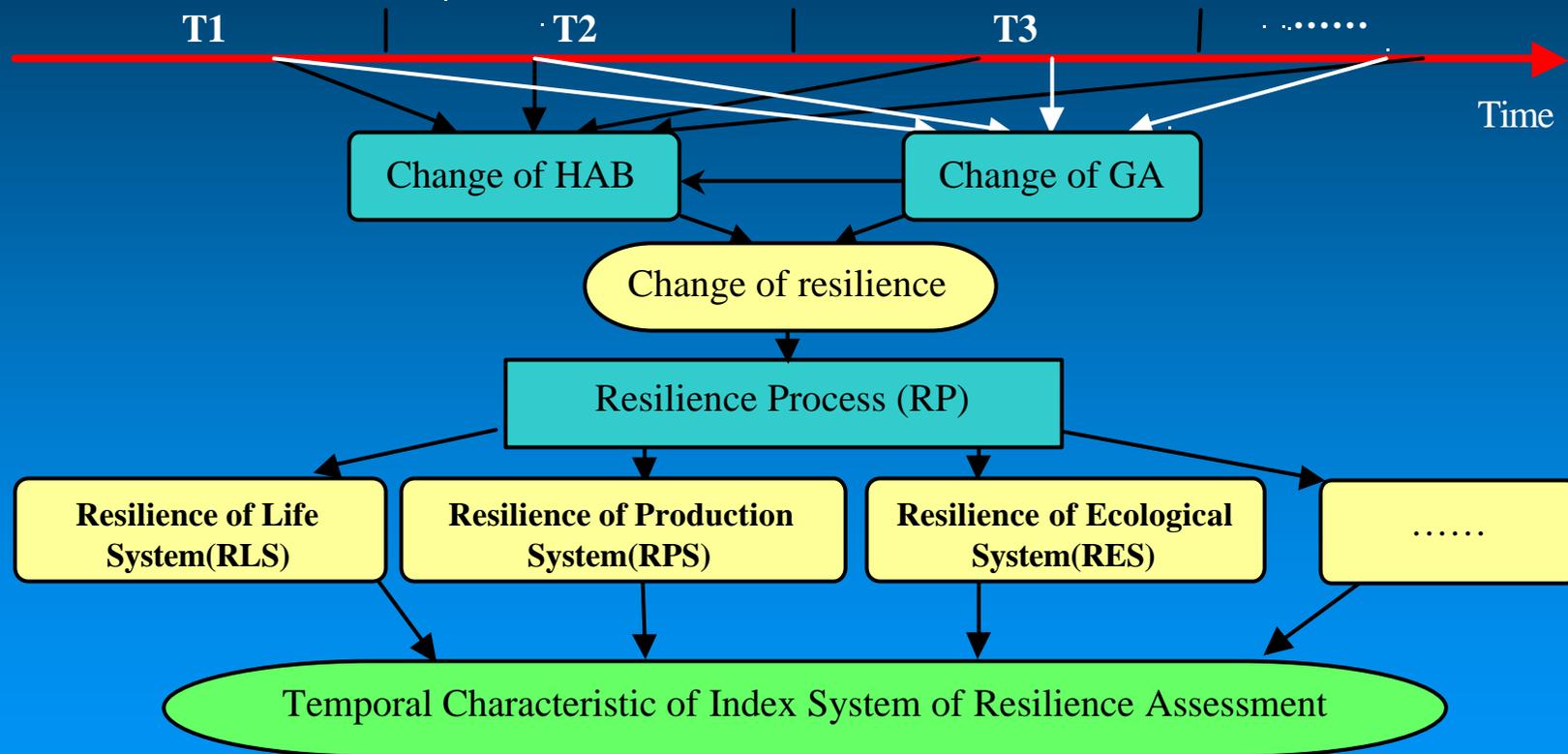
B

C



2. Methodology

2.1 Model of Resilience Process from Temporal Dimension (MRPTD)





2. Methodology

2.2 Data and Methods

- ❏ Firstly, period of time studied was divided. due to various performance and change of resilience in the different socio-economic level, period of time was divided into three stages: T1/1920-1948? T2/1949-1977? T3/1978-2009;
- ❏ Secondly, select several typical cases in each phase: 1920? 1928-1930? 1942-1943? 1952? 1959-1961? 1965? 1972? 1978? 1986? 1988? 1992? 1994? 1997? 1999-2001? 2007? 2009;
- ❏ Finally, explore drought resilience mode in different period and built the corresponding index systems of resilience of agricultural drought based on the conceptualization of the MRPTD.



3. Process

3.1 The Effect of changes of HAB and GA on resilience

Relationship between changes of HAB and resilience

Changes of HAB in T1, T2 and T3

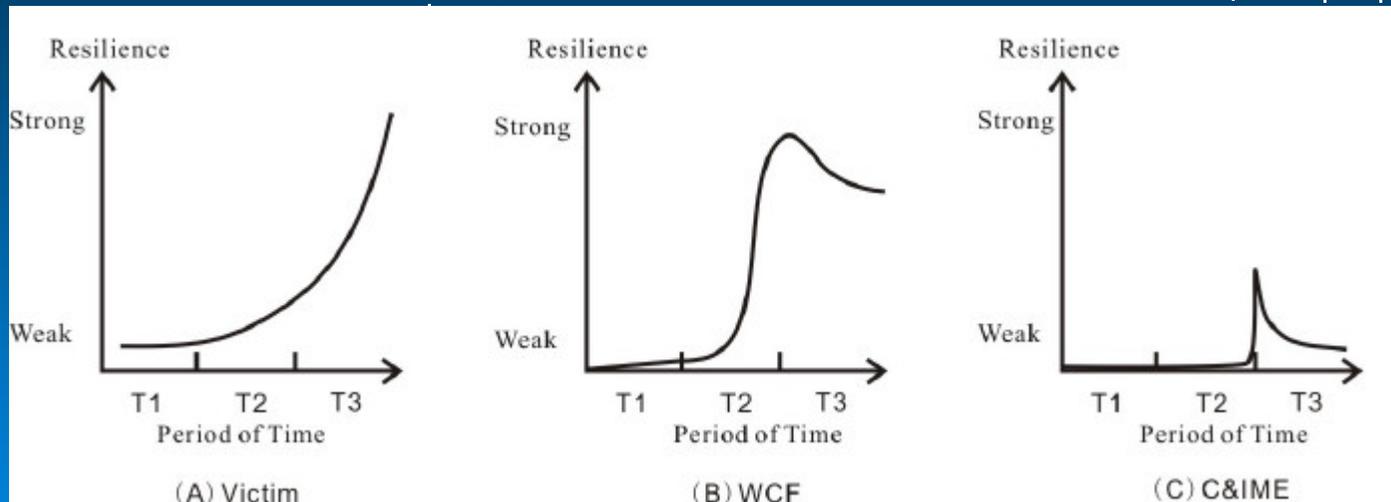
HAB	Time of Periods		
	1920-1948(T1)	1949-1977(T2)	1978-2009(T3)
Victim (V)	Dead (Vd), Flee from famine (Vf), Property for food (Vp), Abandon agricultural production(Va)	Off drink nor food (Vo), Unplanted (Vu)	Hard for drink (Vh), Migration for Work (Vm)
Water Conservancy Facilities (WCF) (W)	Severely destroyed (Wd), Small scope (Ws)	WCF Construction (Wc)	Aging in disrepair (Wa), Function transformation (Wf)
Cities, Industrial and Mining Enterprises (C&IME)(C)	-----	-----	Occupation of agriculture water(Co)



3. Process

The relationship between changes of HAB and resilience

Mode of changes of HAB effect on resilience



- Changes of victims have a positive effect to the enhancement of resilience;
- Changes of water conservancy facilities (WCF) have a positive role in T1 and T2 due to their extensive constructions especially during 1960-70s, and negative role in T3 due to the prevalent ignorance;
- Cities, industrial and mining enterprises (C&IME) have a negative effect to resilience especially in T3 with their rapid sprawl and increasing water demand.



3. Process

3.2 The relationship between changes of GA and resilience

Changes of GA in T1, T2 and T3

Time of Periods		Government Actions
T1	1920/Northern Government	Relief and works agency supervision (Rw), Emergency relief (Er), Porridge factory (Pf), Relief funds allocated next year (Rf)
	1928/Chiang Kai-shek's Government	High proportion of military spending (Ms), Negative drought resistance (Nd), Military snatch to food (Mf)
	1942-1943/Chiang Kai-shek's Government	Delay in taking relief action (Tr), Blockage of drought information (Bd), Low support for disaster relief (Ls)
	1942-1943/Communist Government	Relief work actively (Rw), High support for disaster relief (Hs), Digging wells (Dw), Repair river embankment (Rr), Replant (Rp), Resow (Re)
T2		Disbalance in agricultural production and other industries due to Great Leap Forward (Gl) and Cultural Revolution(Cr)
T3		Active use of WCF (Au), Adequate funds (Af), Grass-roots Anti-drought Service (Ga), Water science and technology Personnel (Ws)

The relationship between changes of GA and resilience can be concluded as that (i) government actions have significant different roles with messy, unbalanceable and orderly government in T1, T2 and T3, respectively; and (ii) the degree of the concern and investment of government on agricultural drought has a positive correlation with resilience.



3. Process



Resilience progress and index systems construction from temporal dimension

3.3 Resilience process mode in three times periods

- ❖ In T1, because life and agricultural production could not be ensured, the most important is RLS. Restrictive factors (RF) played a leading role, which included people death, population migration, land desolation; promotive factors (PF) including government relief, disaster agency relief.
- ❖ In T2, since life could be ensured and production activities would not be interrupted, the focus of resilience process located in RPS and RLS was assistant. PF of RLS played a leading role, which included domestic stocks, government agricultural policy; RF including food gap. PF of RPS also played a leading role, including sowing situation, construction of WCF, irrigation measures and restrictive factors including industrial and agricultural population.
- ❖ In T3, the mode of resilience process focused on RPS, followed by the RLS and RES. (i) For RLS, PF included work out, knowledge of agricultural labor, income situation, government subsidies; while RF including agriculture and non-farm income. (ii) For RPS, PF included irrigation assurance, motor-pumped wells number, science and technology investment, agricultural insurance; while RF including urbanization development, industrial and mining water utilization, aging WCF, industrial and agricultural water of reservoir. (iii) For RES, PF consisted of biological diversity, water resource, soil fertility; while RF including groundwater overdraft, excessive use of fertilizers.



3. Process

3.4 Differences of index systems in three periods

- To study the assessment of resilience of agricultural drought from temporal dimension need to consider the different resilience processes in T1/T2/T3.

Index systems for resilience assessment in T1, T2 and T3

Period of Time	Resilience Process	Factors' Attribute	Index
T1	RLS	PF	Relief amount (Ra), Number of relief agency (Ru)
		RF	Population mortality (Pm), Rate of population migration (Pm), Land desolation index (Ld)
T2	RLS	PF	Domestic stocks (Ds), Government agriculture investment (Ga)
		RF	Amount of food gap (Fg)
	RPS	PF	Sowing rate(Sr), Number of WCF per area (Wu), Effective irrigation area (Ei)
		RF	Proportion of industrial and agricultural population (Ip)
T3	RLS	PF	Work out rate(Wo), Labor education (Le), Net income of farmers(Fi), Amount of government subsidy(Gs)
		RF	Proportion of agricultural income and non-agricultural income (An)
	RLS	PF	Irrigation assurance rate (Ia), Number of motor-pumped wells per area (Mw), Degree of science and technology investment (St), Agricultural insurance (Ai)
		RF	Urbanization rate (Ur), Proportion of industrial and mining and agriculture water utilization (Im), Number of aging WCF (Aw), Proportion of industrial and agricultural water of reservoir (Ri)
	RES	PF	Biodiversity index (Bi), Water resources(Wr), Soil fertility (Sf)
		RF	Degree of groundwater overdraft (Go), Amount of fertilizer per area (Fu)



4. Conclusion



- ❖ **Changes of HAB in different times have a various effect on resilience. Changes of victims have a positive effect to the enhancement of resilience; changes of water conservancy facilities (WCF) have a positive role in T1 and T2, and negative role in T3; cities, industrial and mining enterprises (C&IME) have a negative effect to resilience especially in T3.**
- ❖ **Government actions have significant differences in three time periods, from messy, unbalanceable to orderly government, and play an important role in resilience enhancement.**
- ❖ **Resilience process varies over time, from resilience of life system (RLS) in T1, resilience of production system (RPS) and assistant RLS in T2, to RPS and balance between RLS and resilience of ecological system (RES) in T3. Various index systems should be adopted in different phases to assessment the resilience and several critical assumptions should be put forward before the implementation of resilience assessment.**
- ❖ **To study the resilience of agricultural drought from temporal dimension is only a primary research, and many themes need to be focused in the future, such as only the differences of index systems for resilience assessment in this paper are discussed, not including the same indices in different periods.**



Thanks for your attention!