

Workshop “Adaptation for Climate Change
and Green Development in Mongolia”

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**Lessons learnt from zud events and
adaptation solutions**

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Content

(Reference sources can be found in authors' early publications and in reports of national statistical offices and international financial institutions like WB, ADB etc.)

- ▶ Past shock effects on pasture based livestock husbandry (PBLH) in Mongolia including zud phenomenon and social disturbances and lessons learnt from them.
- ▶ New emerging challenges for PBLH in Mongolia in respect of the ongoing and anticipated global climate changes.
- ▶ Possible adaptation options as a response to the anticipated regional and local climate change with possible interference effect of the globalization
- ▶ Summarized comments

What does mean the word “zud”

The Mongolian word “zud” has been interpreted in many different ways in study reports, scientific papers and etc. Essentially, it is a phenomenon related mostly to a stress on livelihood of local people in rural areas due to external factors such as severe weather conditions in winter and spring seasons, which lead to limitation of access for livestock to pasture grass, water sources and so on.

The term “zud” has a broader meaning

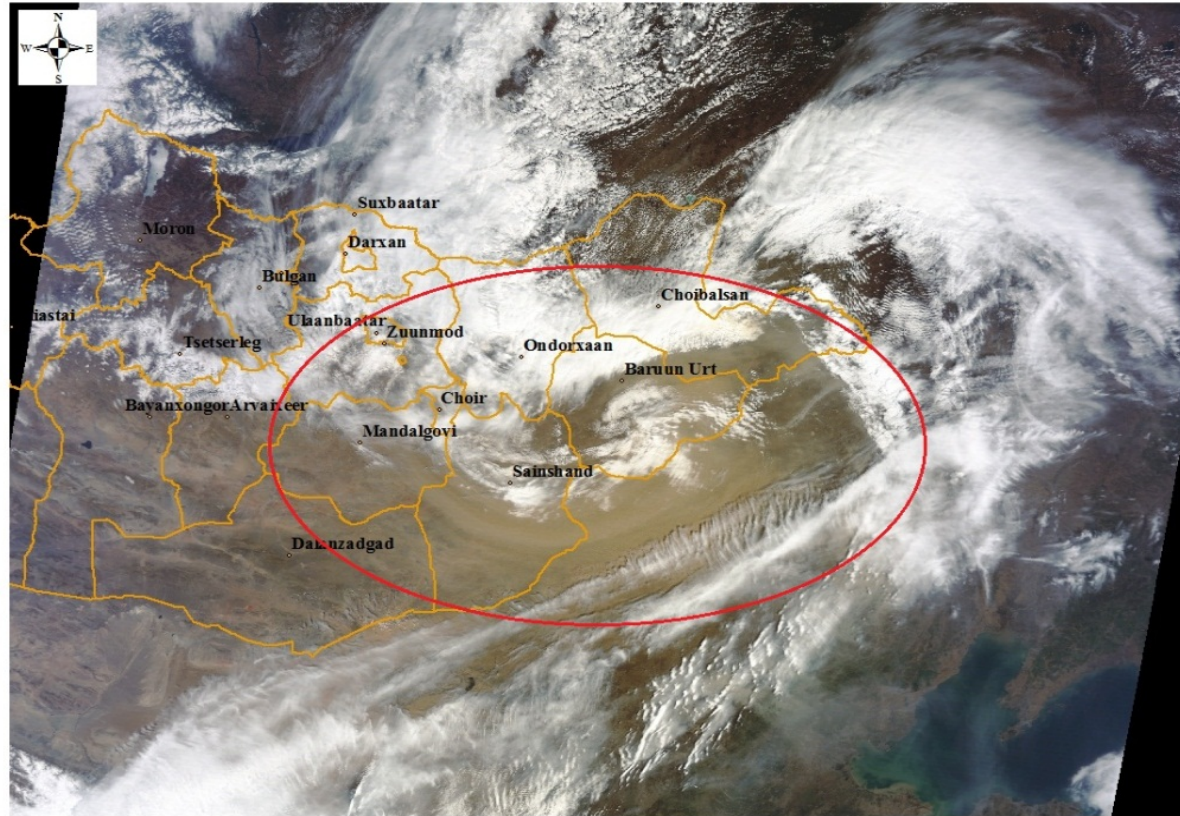
In actuality, the word *zud* has a far broader meaning and may have been derived from the word “*zutakh*”, which means – worsening of the everyday life of people due to lack of food for life sustenance, fuel for heating, water for drinking while loosing livestock as their main source for food, means of transport and assets for revenue. In this regard the word “*zud*” needs to be associated not only with the natural hazards but also the social and economy hazards that go hand in hand as well. *Zud* as a combined natural and social phenomenon can occur in different eco-climate zones of Mongolia in various forms with varying intensity depending on the availability of life supporting natural resources, infrastructure development and traditional way of life of the local people.

How local people differentiate the zud?

The local people differentiate the phenomena as follows: “white zud” when there is too much snowfall, “black zud” when there is too little snow or no snow at all, as well as “ice or iron zud” when ice forms over the snow cover preventing livestock from reaching grass under it, “hoof zud” when there is too much livestock concentration in one place, leading to severe or complete degradation of pasture. “Cold zud” might occur during the cold waves attributed to the Arctic Oscillation (AO) and persisting cold days, particularly in the north-western parts of Mongolia due to “Siberia–Mongolian High” influence in winter seasons. “Storm zud” occurs when atmospheric fronts bring snow storms and sand storms. “Hunger zud” can occur when both livestock and people suffer from malnutrition due to overgrazing of pastures and failure of additional food supplies reaching them due to remoteness and weakness of local infrastructure.

DSS map, which clearly demonstrates the linkage between dust storms and cyclonic activities

Dust storm map. 11, May 2011. 11:28.



Source: NAMEM/EIC

What the history said about zud phenomenon at the territory of Mongolia

According to the historical sources, zud extended to more than a half of the country's territory were recorded during the years of 72 B.C., 1308, 1337, 1340, 1450, 1608, 1626, 1821, 1825, 1839, 1884, 1875, 1891, 1901, 1935, 1944, 1949, 1953, 1956, 1963, 1966, 1967, 1987, 1992 A.D. Surveys conducted since 1640 in the eastern regions of Mongolia (former Tsetsenkhan, Tusheet khan aimags) have shown that zud covering over 75% of the territory of the country occur at least once in 20–22 year–period and winters when zud did not occur even in one soum are very rare.

Zud and drought

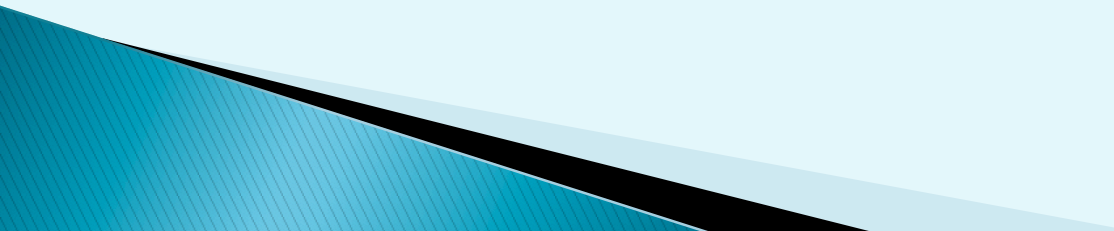
It is proved by many evidences that most disastrous zud events occur mainly after summer–autumn droughts period. During the summer before the year of the Monkey (1994–1945) there was a red drought covered the entire territory of Mongolia, the heavy snow started falling since November and its depth reached 15–28 cm, with bitter frost throughout the winter and over 8 million head of livestock (one third of the national herd) was perished. Similar natural hazards were occurring later but the lost of livestock was less thanks to lesson learnt from it.

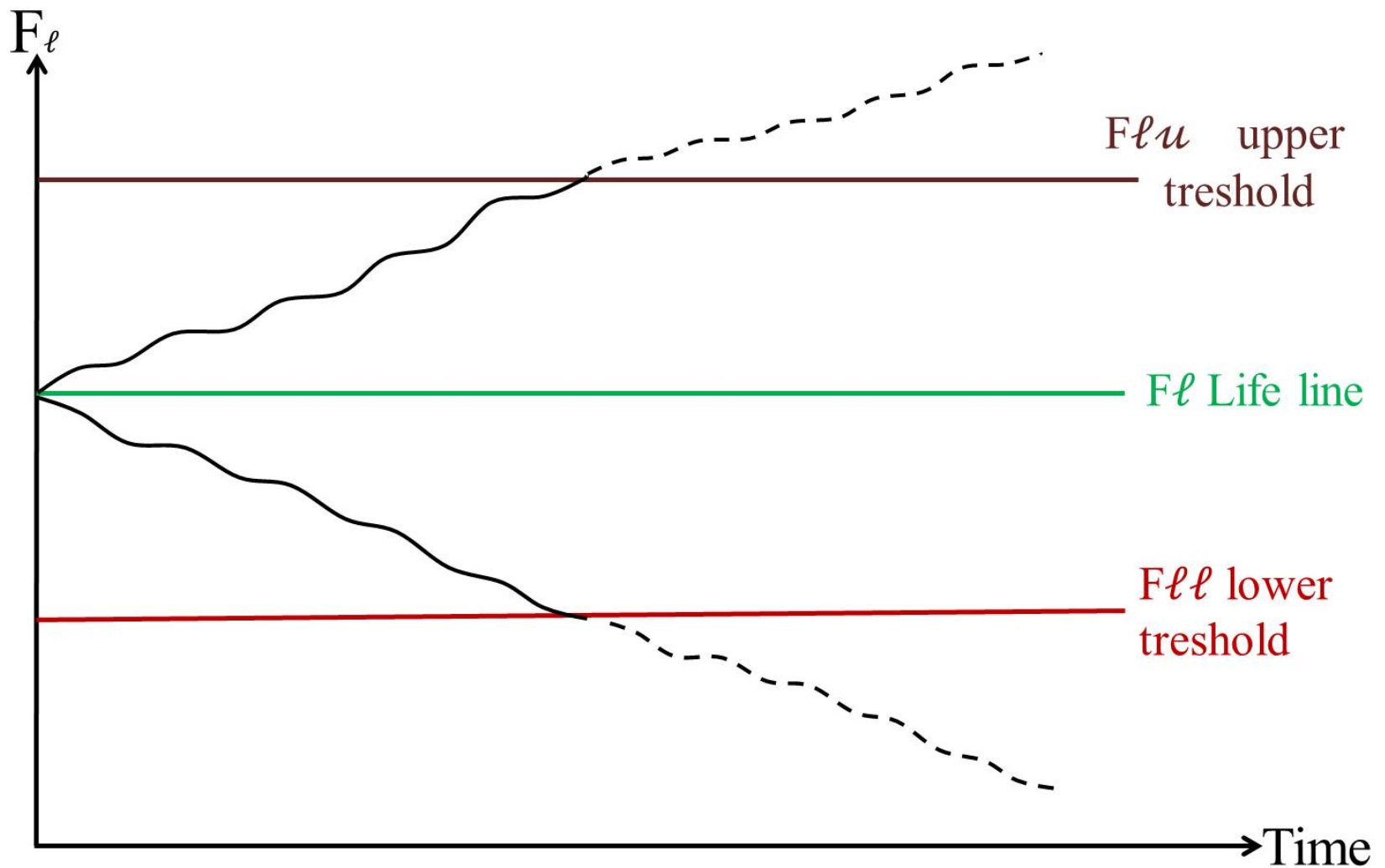
What the history and its modern interpretation said about drought at the territory of Mongolia

Over 90 % of Mongolia's territory is referred to arid, semi arid, moderate arid and moisture deficient regions, 41.3% is occupied by a Gobi desert region which makes the issue of drought and desertification of especial prominence. Drought is regularly recurrent once in 10 years in the country's forest steppe and steppe zone whereas in the desert zone it has a 2-year cycle. According to the historical documents, the red drought occurred in Mongolia in 68 and 46 B.D. and 1248, 1254, 1337, 1372, 1727, 1827, 1952, 1854, 1860, 1882, 1884, 1885, 1892, 1927, 1935, 1941, 1944, 1946, 1951, 1968, 1970, 1972, 1980, 1986, 1988, 1989, 1991 A.D. The drought may be classified with respect to its intensity as slightly droughty – when the grassland yield is poor, droughty – the yield is very scanty, red drought – no vegetation growth at all. When drought lasts for years the ground water's level lowers down, no vegetation flourishing even it is raining incessantly.

The history lessons

The societies in Mongolia during the nation's long history were able to overcome and survive high amplitude of social turbulences, economy turmoil and climate variability, thanks to their lifestyle based on pastoralism. Moreover, it enabled them to maintain a life sustaining system with a **guaranteed provision of the Basic Human Needs (BHN), without stepping over thresholds up and down in life line.**





F_l - Life function

$F_l > F_{lu}$ - Harm for environment

$F_l < F_{ll}$ - harm for human survival

Social turbulences and pastoralism in Mongolia

Until the first **decades of the 20th century** PBLH had been almost the dominant sector in national economy and the basis for **subsistence way** of life for dominant part of the population.

But during the **rest part of 20th century** the PLH in Mongolia experienced several disturbances, mostly associated with **social turbulences**, while **learning lessons**

First shock

First campaign on nationalization of livestock in 1930th was initiated and organized in the name of **equality**. In fact, it was mostly **confiscation** of assets from rich householders and religious establishments like monasteries. Attempts were made to create cooperative units like khamtral (kholhoz in the Soviet Union) , but failed. Total number of livestock had decreased due to over consumption and reduced level of caretaking.

Lessons learned:

People have realized that to deal with domestic animals they need to have an adequate level of **skills and experiences**. Wealthy householders possessed more livestock because of hard work and management skills.

Second disturbance

Second campaign for nationalization of livestock started in 1950–ies was completed by the beginning of 1960–ies. It was some sort of **cooperative movement** slightly or indirectly forced by government policy. **Motivation** was to guarantee sustainable livestock production, livelihood improvement of local people in rural areas and to address unemployment issues.

Cooperative entities or “**negdels**” were established through contribution of assets as livestock and labor. Almost simultaneously **state farms** were established for production of crops and forage for animals.

Lessons with positive outcomes: Rural development and Government support

In 1970–ies the Government was able to manage to create a well functioning network of water supply systems including in certain remote areas , construction of animal shelters in winter camping sites, in seasonal transition zones and even in areas for common use as “otriin nutag” (remote pastures without camping sites), “tuuvriin zam” (soum, aimag transboundary migration routes).

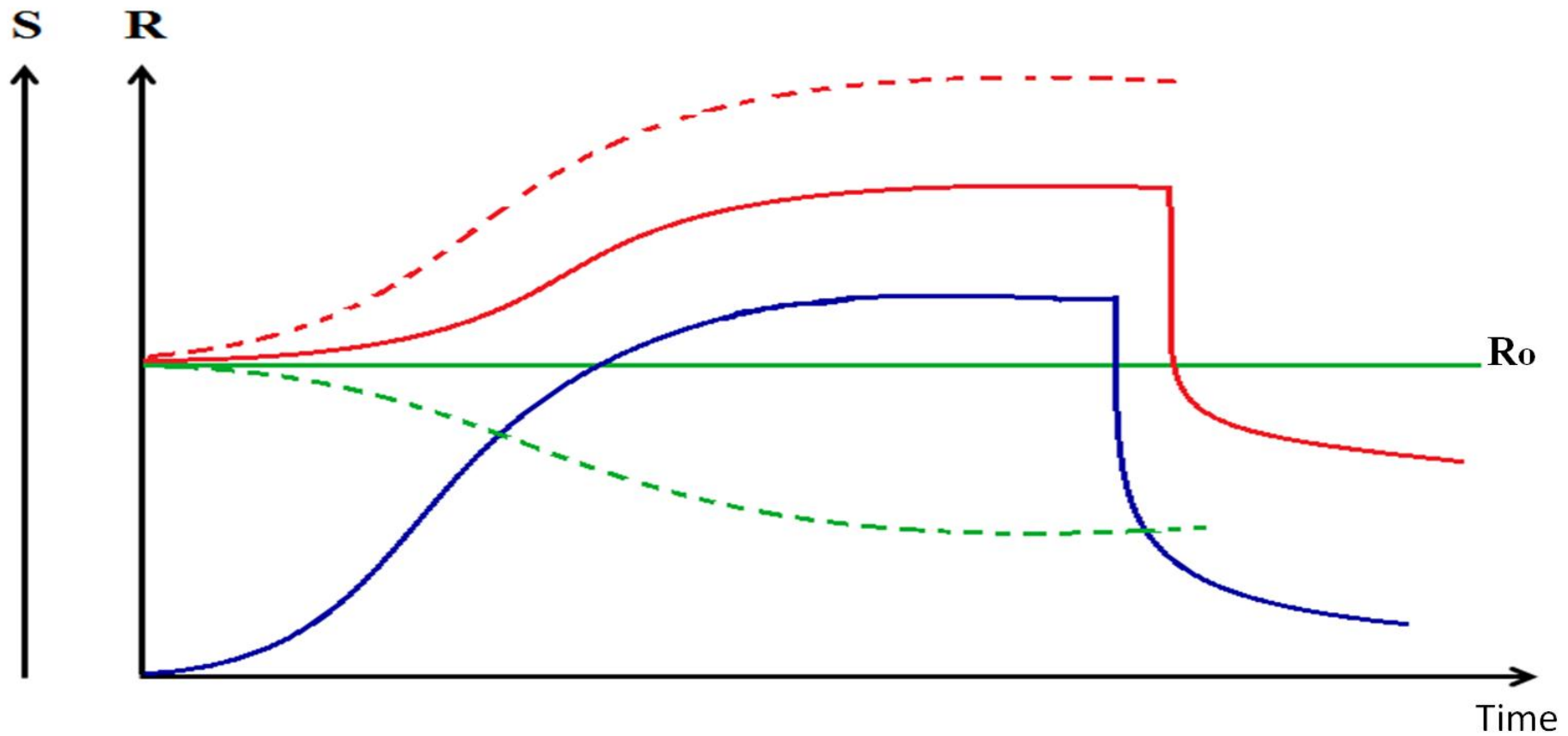
These endeavors, coupled with a free access to all levels of education system and health care services as well as social security network, have enabled people to improve their livelihood. Government sponsored postal and communication services, supply systems and trade networks, and transportation facilities promoted even settlement of people throughout the country.

Lesson: Good intension with a certain non-positive outcomes

- ▶ The Government program prevented, to some degree, **a mass migration** to settlement areas and related **risk of environmental degradation** in areas close to settled places.
- ▶ On the other hand the Government policy to introduce specialization and centralization approaches in livestock management in order to maximize outputs while minimizing inputs has failed in term of efficient use of pasture and other resources, including certain indigenous knowledge and practices.

Another lesson: Good intension with a certain non-positive outcomes

- ▶ Output oriented and centralized planning approaches require an extended human intervention with appropriate investment, which leads transformation of the traditional PBLH as a mature semi-natural ecosystem to a more younger ecosystem which needs continued support.
- ▶ Interruption in overall support might cause collapse of the total resilience as a sum of inherited, gained and engineered resiliencies.



S – Level of expenditures
for take care measures
(—)

R – Total resilience
(—)
 $R = R_o + R_e + R_a$

R_o – Inherited resilience
based on biological and
self organizing capacity
(—)

R_a – Altered resilience due
to reduced biocapacity
(- - -)

R_e – Engineered resilience
(- - -)

Third disturbance

Dismantling of negdels as well as of state farms at the beginning of transition to market economy in 1990-ies was another **shock for the agricultural sector**. It coincides with the widespread privatization of the state owned factories and enterprises, most of which were not able to continue production and business activities. It means that the established **domestic market** for livestock products (like wool, skin, cashmere etc.,) was diminished significantly. Several thousands of animal shelters, motorized wells, water distribution facilities, irrigation systems were destroyed and abandoned due to **lack of ownership**.

Lessons learned

Failure of the government policy on privatization and people's naive expectations that the free market economy mechanism will settle everything by itself solving all of their problems.

Politicians very late have realized that Mongolia has certain specifics for transition to market economy due to lack of experience in the past and a limited "space" for a full functioning of market principles and mechanisms.

Fourth shock

This shock was associated with the **rapid increase** of livestock in the contrast to the previous shocks which were leading to reduction of livestock number. Most scholars tend to attribute these changes to the **privatization** of livestock. *It is true in part.* Other reason for that was Mongolia has lost its market for livestock and livestock products as former Soviet Union and Eastern European countries.

Another important feature of this shock is the structural change in the livestock sector in terms of **livestock composition**. The increased number of goats was related to the interest for profit as a prompt response to market signals.

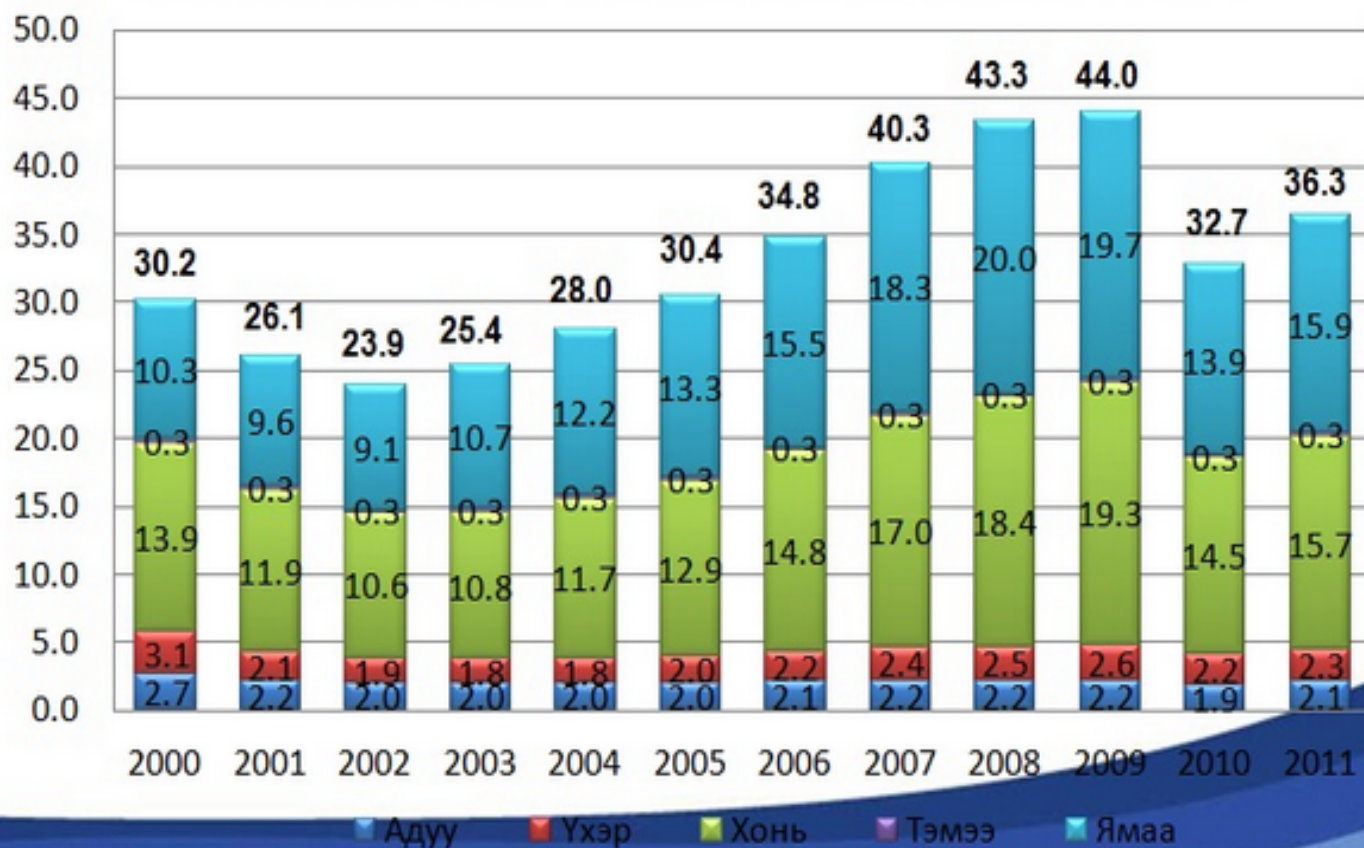
Livestock composition change



ҮНДЭСНИЙ СТАТИСТИКИЙН ХОРОО

Салбарын статистик үзүүлэлт

Малын тоо, малын төрлөөр, сая. тол, жил бүрийн эцэст



Side effect of globalization?

Globalization versus tradition?

What is tradition? Who needs tradition?

Traditional lifestyle is not merely a subject of identity for Mongols or subject for tourist attraction. It is the most accessible for everyone option for the BHN, based on the guaranteed available resources, as vast grasslands and available capacity in the form of traditional knowledge tested and shaped throughout thousands of years of the nation's existence.

The concerns are raised in relation with globalization impacts from the possible **overturned effects of high tolerance** of “nomads” to any new elements in life sustaining systems, which might include non native, but more disturbing and life changing “cultural” elements.

Political changes and livestock management

In Mongolia, the traditional herding system follows a four-season pattern, grazing different pastures at each season, thus distributing the grazing load, with strategic short-distance moves, *otor*, to other pasture with different categories of animals as part of the routine and also helping to spread grazing and make best use of resources.

Political changes and decollectivization have affected the movement and management of livestock in Mongolia and collapse of rural infrastructure and pumped water supplies have led to many areas remaining ungrazed (Source: FAO).

**Tower for cell
phone network**



Cold and wet air

Dry and warm air

Dry and warm air

Dry and warm air

Winter camping site

Winter camping site

Winter camping site

Winter camping site

Winter camping site

Winter camping site

Winter camping site selection in the past and in modern days



Current nation's development paradigm shift

Development paradigm based on:

❖ human capacity, including traditional way of life, enriched by modern science based knowledge and technologies

or

❖ paradigm based only on:
natural resources.

Dilemma for economic development

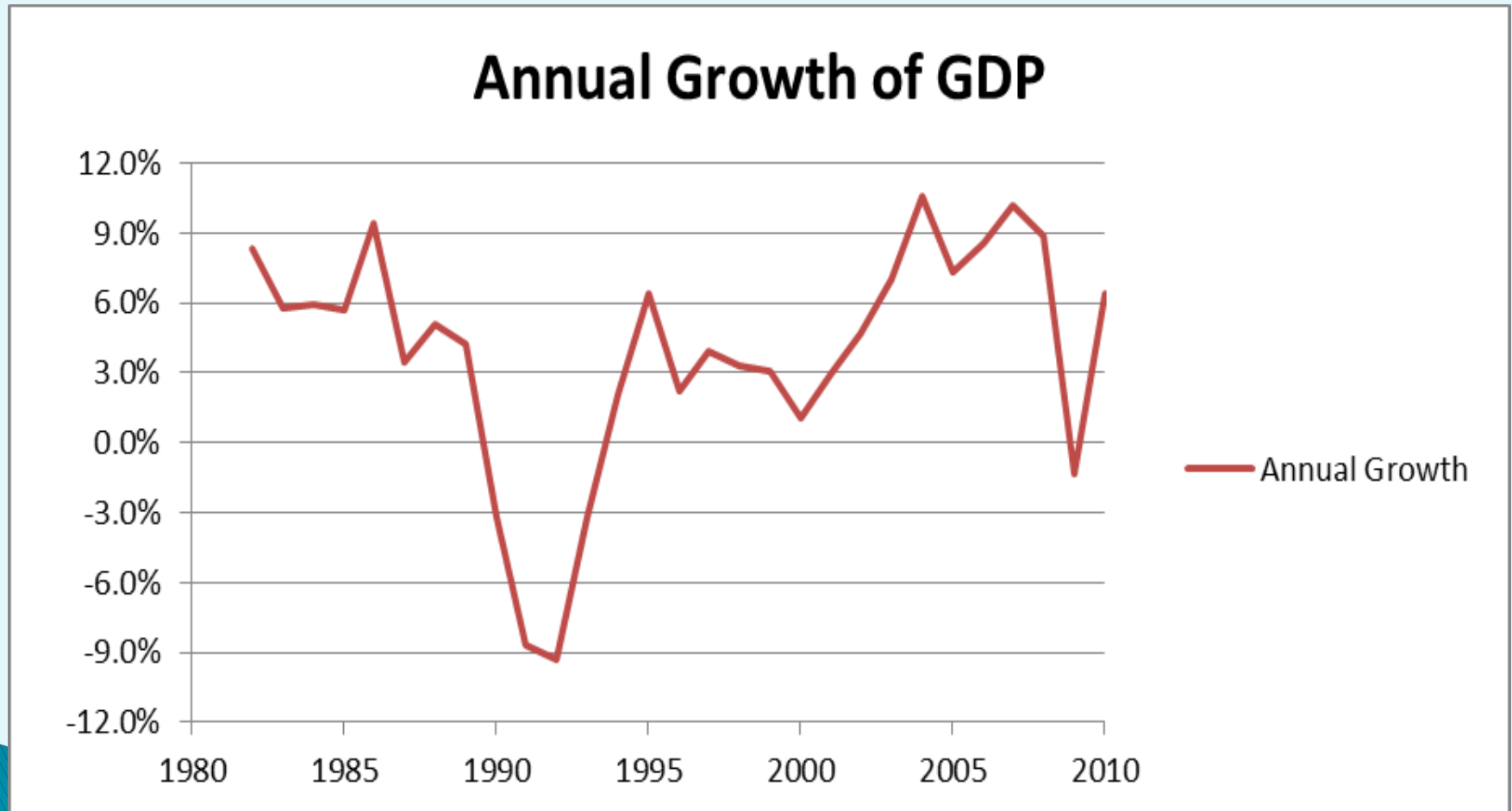
Economic development based :

➤ on **renewable resources** like pasture for grazing, nature beauty, solar radiation, wind, natural heat and cold, water, open space etc.,

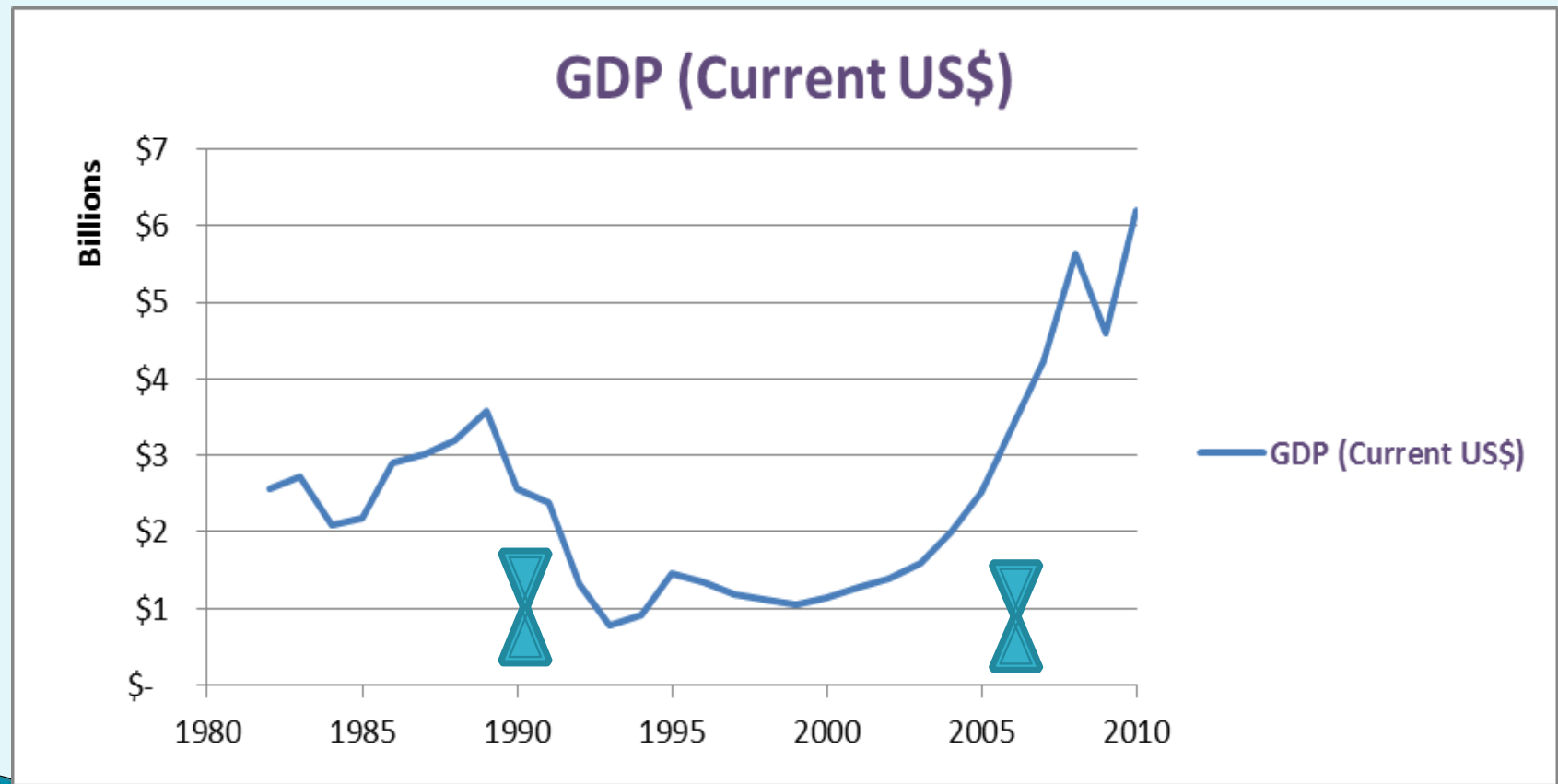
or

➤ on **extractive mineral resources** like coal, copper, gold and others

Impact of societal turbulences: GDP fluctuation in Mongolia during the last three decades



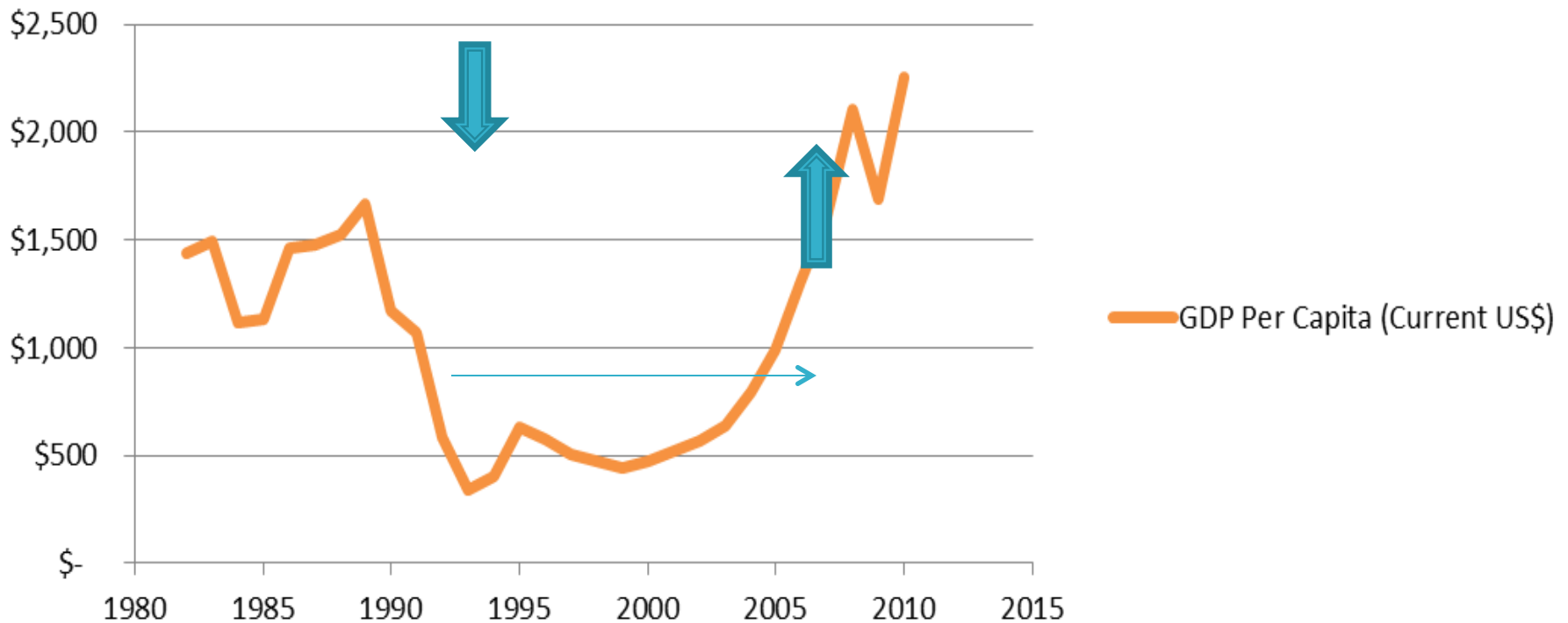
Cost of continued lessons (lost years): GDP of Mongolia before, during and after transition



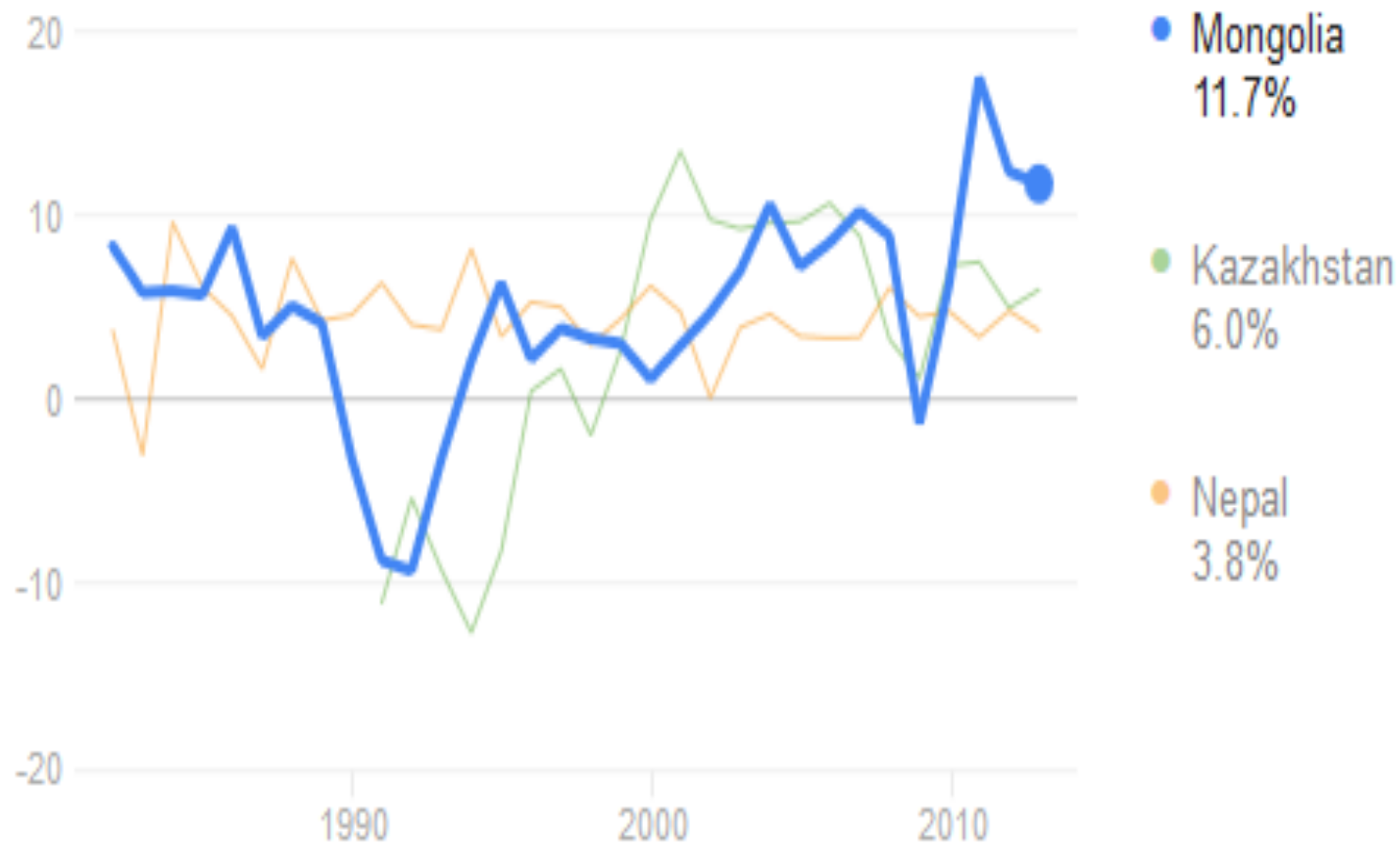
Past lessons, future benefits?

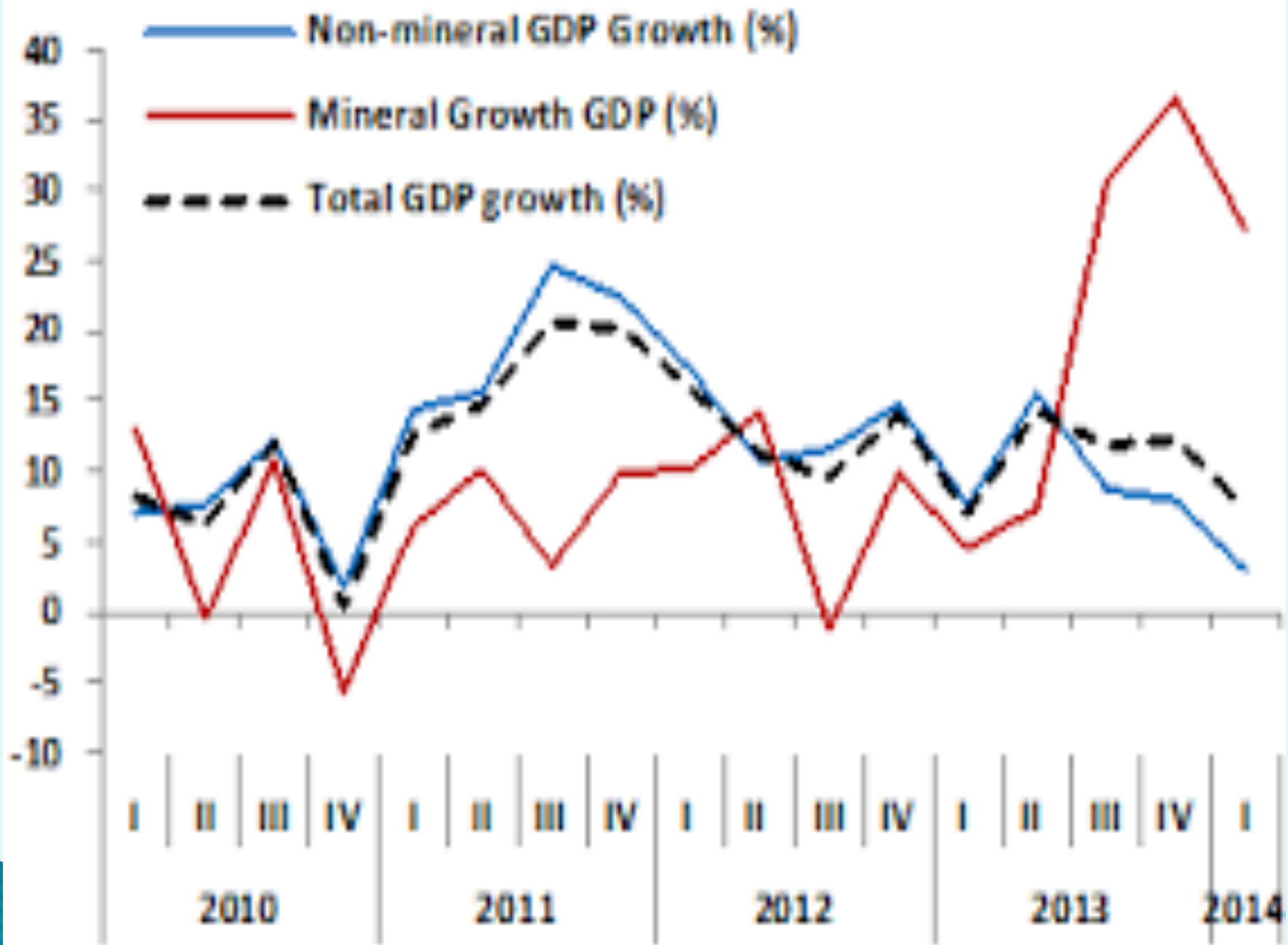
GDP Per Capita before, during and after transition

GDP Per Capita (Current US\$)



Mongolia, GDP growth rate





What does mean country's GDP growth for individual citizen of Mongolia

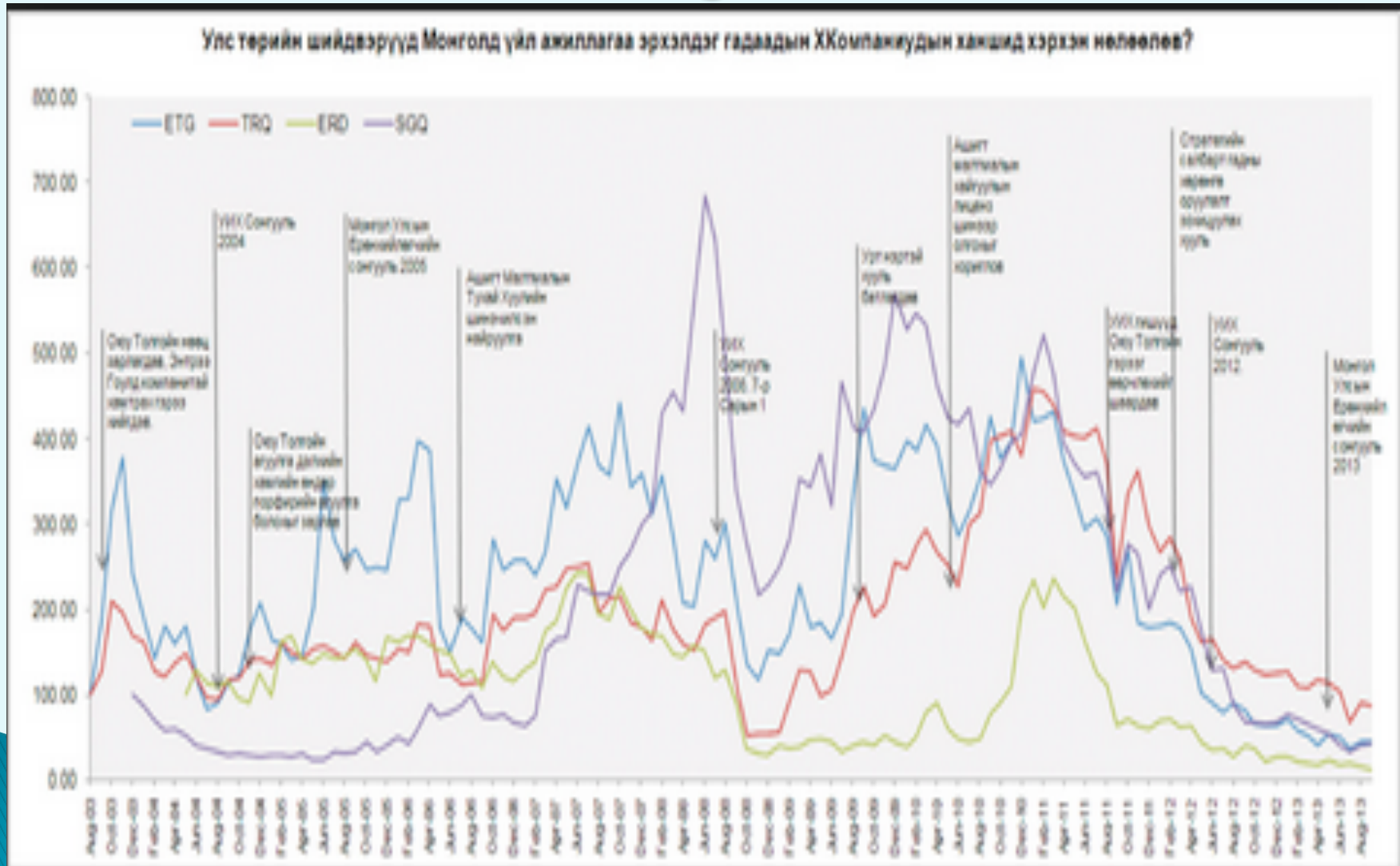
Because of a boom in the mining sector, Mongolia had high growth rates in 2007 and 2008 (9.9% and 8.9%, respectively). Due to the severe 2009–2010 winter, Mongolia lost 9.7 million animals, or 22% of total livestock and GDP dropped 1.6% in 2009. Growth began in 2010, with GDP increasing 25.3% over 2009 as Mongolia emerged from the economic crisis. GDP growth in 2012 has reached around 17%. However, inflation continued to erode GDP gains, with an average rate of 12%.

Unfortunately *not much* contributions so far for the *prosperity* of every one in this country from rapid GDP growth attributed to the mining boom.

Stability of the mineral resource based economy of Mongolia (GDP) depends on the global economy fluctuation



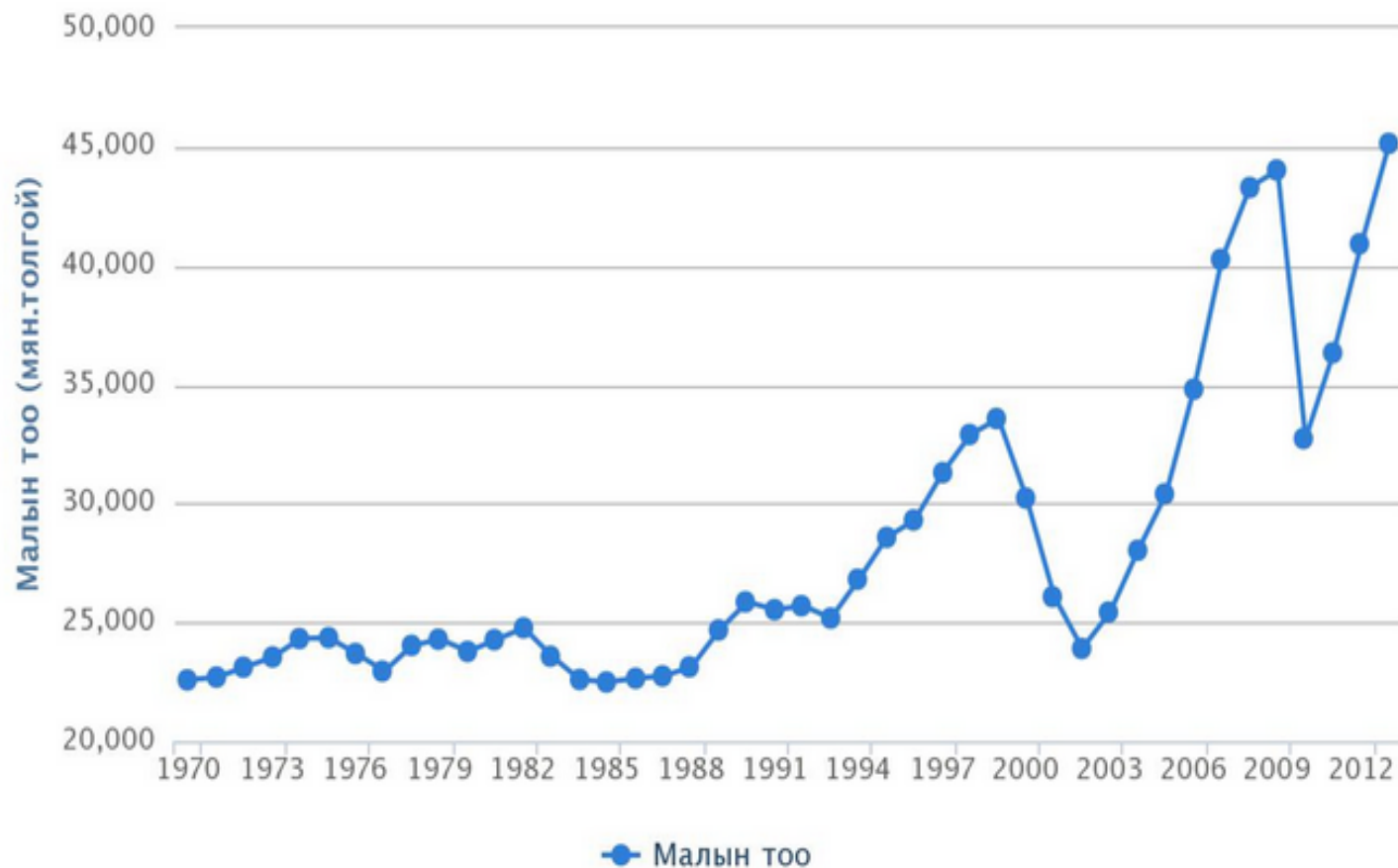
Impact of the Government policy change on the business of companies with FDI in Mongolia



PBLH has served again as a buffer from economic turmoil and livelihood collapse during the transition

Малын тоо, оноор, мян.толгой

Эх сурвалж: Монголын Үндэсний статистикийн хороо



Record number (51.9 million head) of the livestock growth(15.1%) in the year 2013/14 thanks to favorable weather without drought and zud

ҮНДЭСНИЙ СТАТИСТИКИЙН ХОРОО

МАЛ ТООЛЛОГЫН 2014 ОНЫ УРЬДЧИЛСАН ДҮН

МАЛЫН ТОО, мян.тол, аймаг, нийслэлээр



Мал тооллогын 2014 оны урьдчилсан дүнгээр малын тоо **51.9** сая толгойд хүрч, өмнөх оныхоос **6.8** сая толгой буюу **15.1** хувиар өслөө.

Dilemma for Pastoralism

Question is raised:

to be or **not to be** for the traditional pasture based livestock husbandry (PBLH) in Mongolia.

The question was out of discussions for thousands of years. Why it so important is for today ?

Newly emerging pressure on the PBLH associated with competition among economic sectors.

Crop production

Some portions of grasslands were converted to crop fields during the “Virgin land” campaign in the 1960–ies. During this period state owned farming entities called “Sangiin aj ahui” were established dealing with mostly crop cultivation in different parts of the country, where soil fertility and precipitation amount permitted crop cultivation. It was a risky business and crop yield was not high enough and mostly was depending on the spatial and temporal precipitation patterns. With proper management this **should not cause a big stress for PBLH** not only because of the insignificant portion of the crop land area to be involved, but also because of the **complementarities** of the two sectors to each other in many ways.

Recent “ Third Virgin land campaign” is a political game with negative impact or necessity ?

The Government has decided to reactivate the crop production program under the slogan “ Third Virgin land campaign”, based on the market principles and with engagement of private companies. As result the crop production in this country kept up and improved and at present it reached the level of 1980-ies, covering major portion of the domestic demand. In 2014, for instance, crop yield was enough to cover domestic demand with surpluses and per hectare yield was highest in last several decades. The crop field area can be extended up to 2 million hectares, which is 1.3 % of the national land area or 1.6 % of the agricultural area.

Mining, mining....

Another strongly competing with PBLH sector for today is a mining sector. Actually, the size of grasslands directly involved in the mineral extraction processes is not a big issue. However, mining activities are spreading, rapidly occupying more and more land for transportation, for new settlements, for water sources etc.

Mining does not offer anything for complementarity with PBLH except the limited **market opportunities** for livestock products in the areas close to mining villages and camps.

What does mean a mining in Mongolia.

The mining industry's output is largely based on **copper and gold**. Gold production comes mainly from placer operations.

Artisanal and small-scale mining (**ASM**) is escalated to being the main livelihood for tens of thousands of people (between 30,000 and 100,000 participants) during difficult period economic transition, and became, to some extend, a **social safety net** for herders who lost their herds in natural disasters(zuds).

Environmental Impacts of mining

Changes in hydrological regimes remain a significant problem, particularly for placer gold. On balance, current mining practices are inefficient and use excessive process water, thus overtaxing surface waters and underground supplies, and also generate excessive effluent, which is difficult to manage and poses a threat of uncontrolled discharges of slurry.

In addition, where rivers are illegally dredged and where tailings are discharged into surface waters, turbidity of surface waters is a major concern, since PBLH needs free access to good quality water sources.

Environmental Impacts of mining:

New challenges for the PBLH which operates , assuming that pasture and water sources are not polluted.

Land pollution and toxic chemicals issues

Waste–Rock Piles and Tailing Repositories.

Rainfall washes gravel and soil down into valleys, where valuable grazing land can become polluted. In addition, acid mine drainage (AMD) is becoming a growing concern.

Mercury Pollution. Mercury was banned from gold mines but today it is used illegally in a few placer and hard–rock mines in Mongolia. Some other toxic chemicals also involved in mining operations.

Health risk due to air pollution from mining activities

Lower air quality from ASM is posing a growing health threat. Dust generated by placer ASM—by shoveling, scraping, chiseling, bagging, and spillages in a confined space with poor ventilation—causes eye injuries, bronchial complaints, and silicosis. Even more dangerous is the smoke from fires to melt permafrost, particularly black smoke from tires, which contains carbon particles, carbon monoxide, polyaromatic hydrocarbons, benzene, phenol, and cyanide.



2011/11/23



Supposed impact of uranium mining in Mongolia (lamb with two heads as it was informed by Russian media recently)

Монголд мутантууд төрж байгаа нь ураны уурхайгаас болсон



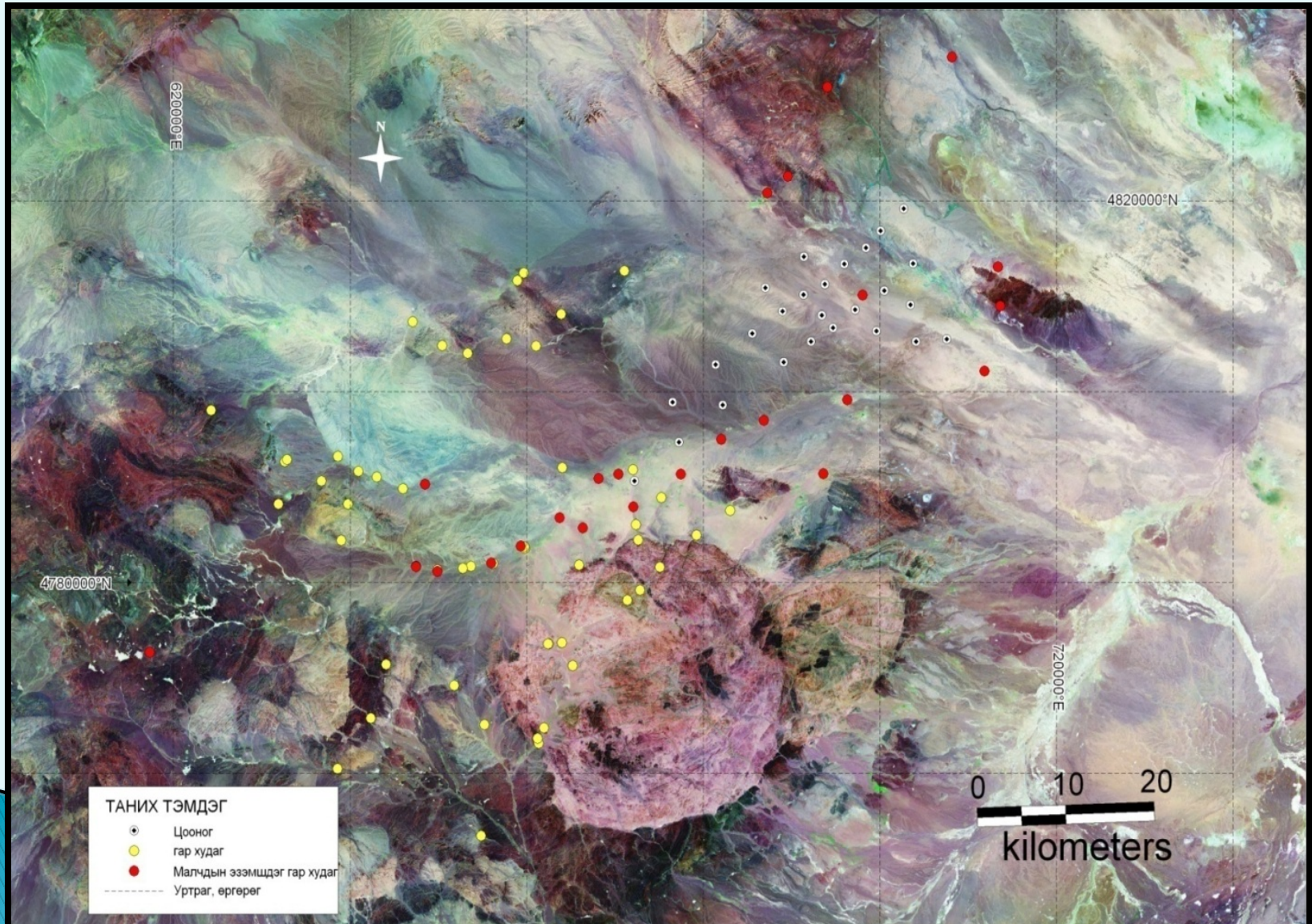
Big scale of mining in water scarce Gobi areas, its impact on local people livelihood and on society as a whole

An anticipated doubling of GDP over the next decade will potentially lead to degradation of both surface and ground **water quality and quantity**.

The economic growth will be driven by **large-scale mining** projects primarily in the water-scarce south **Gobi region**.

These activities will require large amounts of water for industrial operations (primarily from **underground aquifers**) and to meet the needs of new mining villages and settlements.

Intensive industrial use of ground water in the Gobi region will lead to diminish of ground water , accessible to local herders.



Watering camels in Mongolia.

Courtesy: ALICE CARLONI



Climate related stresses

Strong shock, associated with extreme weather events had occurred in 1944 and was called as **the “monkey year zud”**.

Lessons learned:

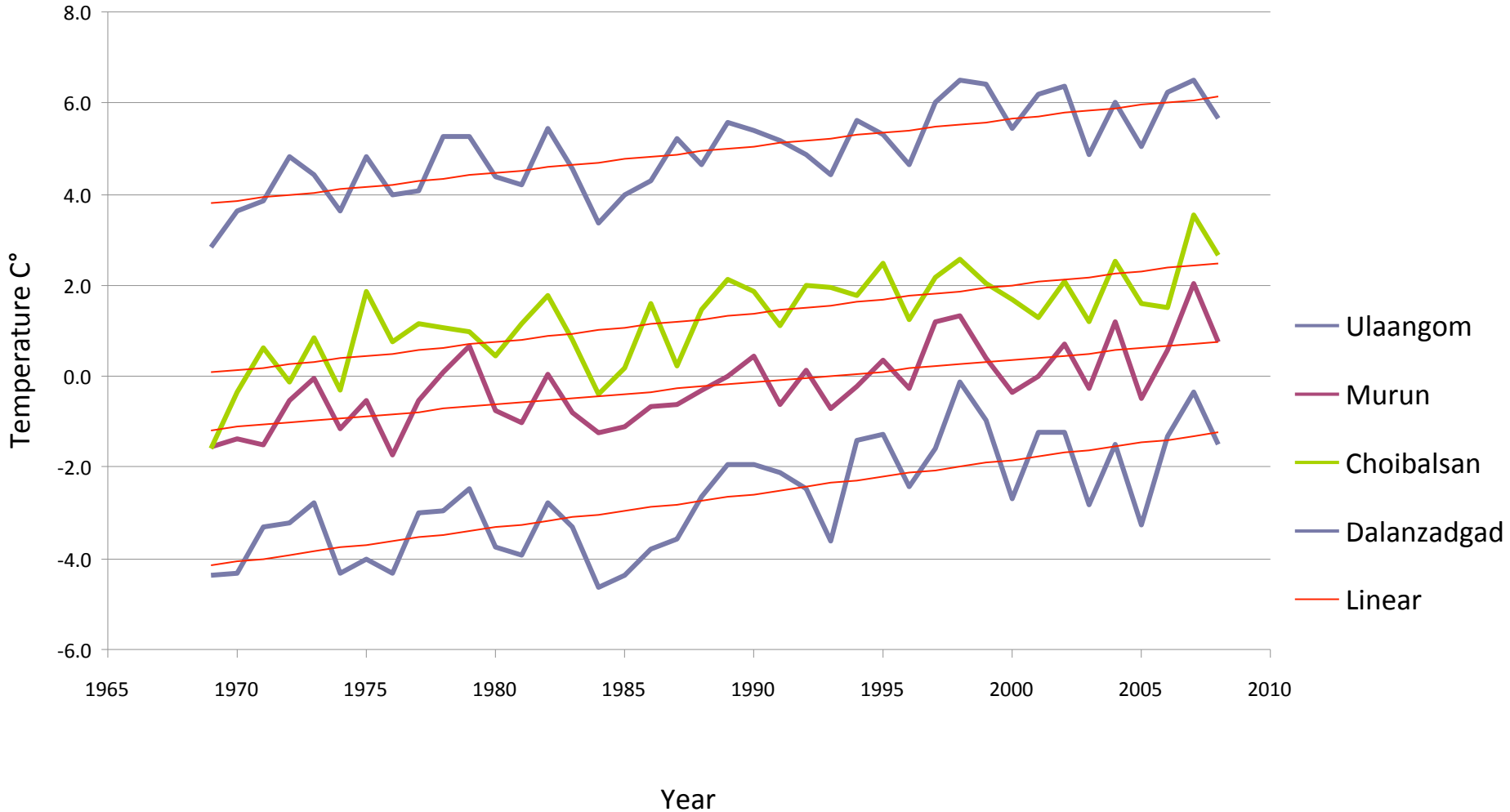
Government and people understood that livestock needs **protection from extreme weather events**; there is a need to have stock of forage that can be used when animals can not leave camping site due to heavy snow fall, snowstorms, strong winds etc.

PLH and natural disasters (zud)

牧畜、自然災害

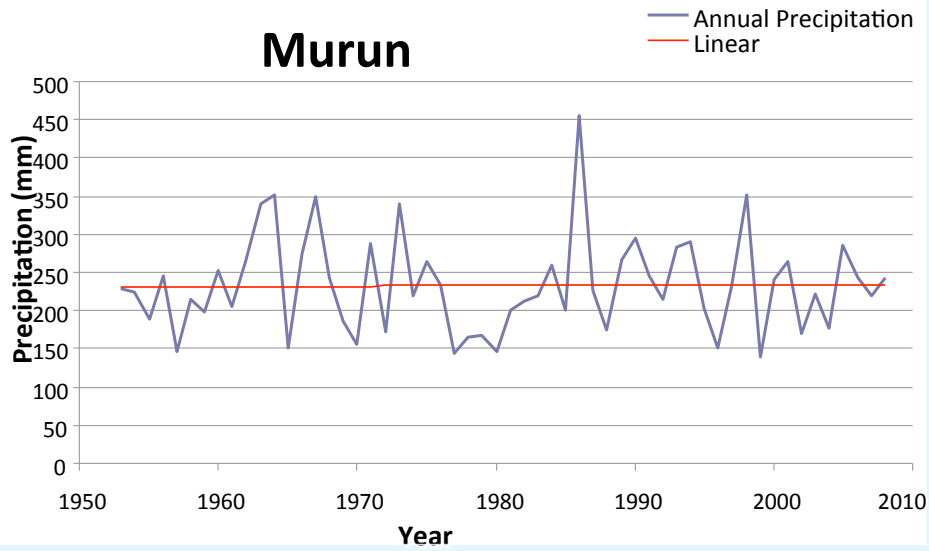
Year	Number of aimags affected	Loss of animals				Value of losses, Mill. Tugrik	Total loss, Mill. Tugrik	Costs for compensation, Mill. Tugrik
		Adult animals		Young animals				
		number, mill. Head	%	number, mill. Head	%			
1944-1945	9	8.1	33.2	1.1	17	-	-	-
1954-1955	9	1.9	8.2	0.3	4	-	-	-
1956-1957	11	1.5	6.2	0.9	12	-	-	-
1967-1968	13	2.7	11.9	1.7	21.6	-	-	-
1976-1977	15	2	8.6	1.6	10.7	-	-	-
1986-1987	11	0.8	3.6	0.9	9	-	-	-
1993	4	1.6	6.4	1.2	13	-	-	-
1996-1997	11	0.6	2.1	0.5	5.4	-	-	-
1999-2000	13	2.24	6.7	-	-	85,900.0	87030.0	1130.8
2000-2001	20	0.34	1.1	-	-	150,000.0	150884.0	884.0
2001-2002	7	2.07	7.9	-	-	103,000.7	105400.0	2400.0
2003	13	0.68	2.8	-	-	33,300.0	35512.5	2212.5
2009-2010	10	9.7	22.1	-	-	600,000.00	606400	6400

Temperature Trend in Different Distinct Ecological Zones (West, Center, East and South) in Mongolia (Average Temperature)

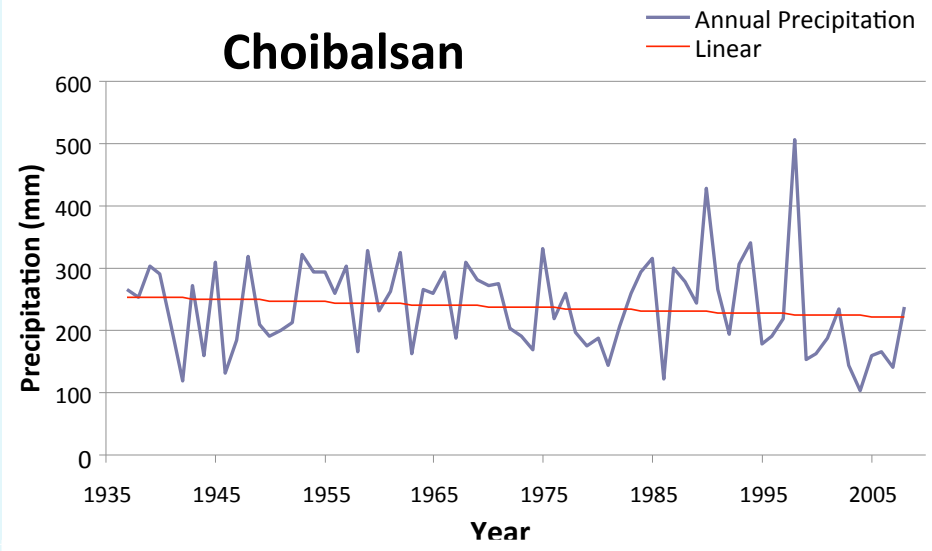


Precipitation Trend in Different Distinct Ecological Zones (West, Center, East and South) in Mongolia

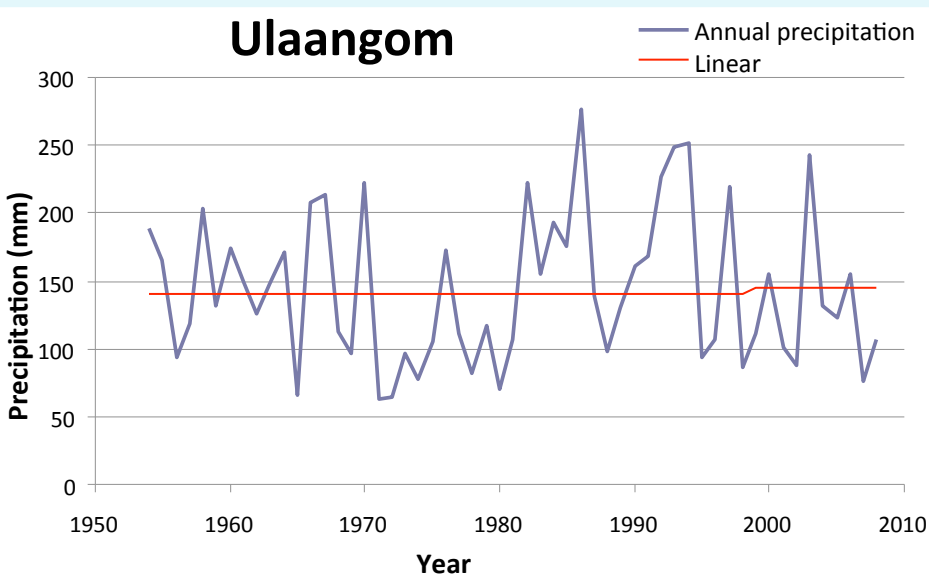
Murun



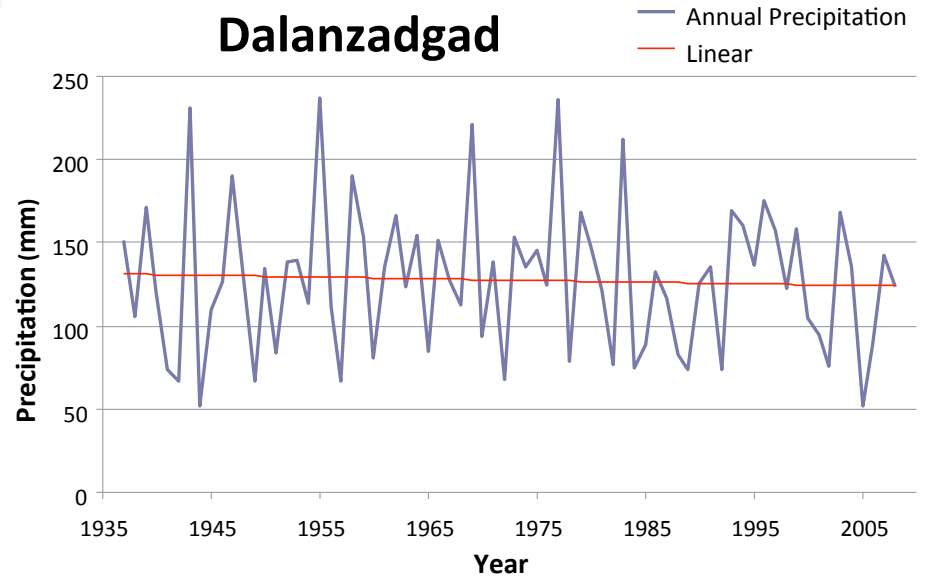
Choibalsan



Ulaangom



Dalanzadgad

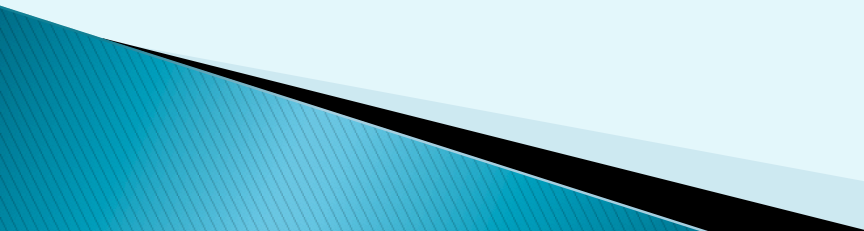


Principal message from the climate change studies as basis for policy making:

- ▶ Present global warming in the long run would lead to the **shift of climate zones with more dominance of arid and semi-arid areas in Mongolia.**
- ▶ **Vegetation zones will move to the north and semi desert and steppe zones will expand .**
- ▶ **Aboveground biomass will be diminished and pasture quality will be deteriorated.**

GCM projections for the 21st century

(AIACC, MARCC) :

- ▶ Dry and hot summer, milder but more snowy winter.
 - ▶ Evapotranspiration is much higher than the projected slight increase in precipitation.
 - ▶ The severity of extremes like drought might be doubled by 2080.
- 

Projected impact on livestock

- ▶ The area unfavorable for animal grazing would increase from the current 40 % to about **70 % by 2050**, and 80 % by 2080.
- ▶ Animal mortality estimated to reach about 12 % by 2020,
18–20 % by 2050 and 40–60 % by 2080
- ▶ **Decrease of animal productivity** (based on projected decrease of the ewe weight of animals due to shortened grazing time because of heat stress)

Predicted future for pastoralism in Mongolia:

The climate change study reports said that increased extremes resulting from climate change are **significant barrier to livestock sector** development and this impediment would grow significantly over the next 80 years.

NO FUTURE FOR PASTORALISM IN MONGOLIA ?

- ▶ Researchers said: **Pastoral nomadism in Mongolia is not out-of-date, but modern**
(Source: Fujita et al. 2012)

Science can do more ?

These traditional ways of life and its change due to social turbulences and climate stresses partly described here are not just a sentiment or problems without solutions. **Certain parameters of these dynamic systems can be predicted using theoretical modeling instruments** (Yamamura et al.2012)

A principal goal of the RIHN project “Collapse and Restoration of Ecosystem Networks with Human Activity” was **to design a model that could simulate a network of social and ecological systems which are able to function on inclusive principles with maximum use of ecosystem services.**