

Indigenous Knowledge – A Human Capital for Response to Climate Change in Agriculture at North Central region, Vietnam

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Abstract

Climate change is increasing water disaster phenomena such as typhoons, floods, droughts, inundation, and salinity intrusion in coastal regions in Vietnam, typically in North Central Region. Climate change induced water disaster impacts directly on daily living activities, livelihood, and increases the vulnerability of communities who already have many difficulties. The best long-term adaptation measure is to strengthen response capacity and promote the development of sustainable livelihoods for households. Indigenous knowledge accumulated in dealing with water disaster phenomena in agriculture has been one of resources takes a important role in the maintenance of their lives. This paper will answer some questions such as what is indigenous knowledge? How to use in response to climate change-induced water disaster in the North Central region of Vietnam.

Key words: Indigenous knowledge, Water disaster, Climate change, Agricultural, North Central region of Vietnam.

1. Introduction

Climate change (CC), especially through extreme climate events (ECEs), is currently a major threat to Vietnam's socio-economic development. A remarkable thing is that CC impacts on the national economy are significant and increasing, even potentially heavy impact on particularly the livelihood security of the poorest rural population segments. Knowing the risks above, the Vietnamese government has established the National Target Program to Respond to Climate Change, with the aim of improving resilience and reducing vulnerability to CC of localities across the country. The Ministry of Agriculture and Rural Development (MARD) has also established the Action Plan Framework for Adaptation and Mitigation of CC (APFAMCC) in the Agriculture and Rural Development Sector for 2008-2020, which emphasizes the climate change response activities towards sustainable development in localities, especially in less developed areas and poverty areas.

The North Central region of Vietnam with three typical provinces namely Nghe An, Ha Tinh, and Quang Binh (NHQ) has a population of about 5,1 million inhabitants³ of

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³ General Statistics Office (2013). Survey on Population and Family Planning change in 1/4/2013: Major finding, 328 pages, p.89.

which 70% are living in the delta and coastal areas, with most of these inhabitants' livelihood relying on agriculture and fisheries. Due to the geographical and socio-economic conditions, NHQ remain the second lowest GDP-per-capita region in Vietnam. With about 350 km of coastal line open to the East Sea, the delta and coastal areas of these provinces is inherently affected by severe water disasters such as typhoons, floods, droughts, inundation, and salinity intrusion. Only during 2010, the NHQ coastal region suffered two opposite events: a long drought in June-July and two consecutive strong floods in October. Consequently, the heatwave in June caused the loss of about 30,000 ha of the summer-autumn paddy. In October 2010, these provinces were strongly hit by two consecutive floods caused by the heavy rainfall (800–1,658 mm) and causing considerable damages over a huge territory in these three provinces.

Obviously, climate change-induced water disaster could adversely affect some parts of the communities in the present and future, and the best long-term adaptation measure for vulnerable communities is to increase their capacity for response to disasters based on five livelihood capitals and promoting sustainable livelihoods for households in the communities. In the context of agricultural being still the main source of livelihood of households, the production relying on water resources, the indigenous knowledge and experience amassed in the process of coping with climate change-induced water disaster in the agriculture of the communities is human capital, plays a crucial role in the maintenance of their lives.

Based on qualitative data collected from field research of the Institute for Population and Social Studies, National Economics University at three typical communes in three provinces in the North Central region⁴ in the framework of research cooperation project between Vietnam and Denmark on “Climate Change-induced Water Disaster-Information System for Participatory Vulnerability Reduction in North Central Vietnam” (CPIS_11-04-VIE), this paper reviews and clarifies the concept of indigenous knowledge, describes and analyzes the extent of using the indigenous knowledge of local communities to response to CC-induced water disasters in agriculture in the North Central region, Vietnam.

2. Indigenous knowledge – human capital in response to climate change: Concept and international experiences

Knowledge is a philosophical term and can be conceptualized as a set of various facts and information. It can be divided into two categories: scientific knowledge and indigenous knowledge. “Scientific knowledge” is defined as the knowledge can be proven scientifically; meanwhile, “Indigenous knowledge” is considered as knowledge of local ethnic people (*Ashok Das Gupta, 2012*). The term of “indigenous knowledge” is used to describe the knowledge system that is developed by a community in contrast to scientific knowledge called “modern knowledge” (*Ajibade, 2003*). Knowledge is the human capital – one of five livelihood capitals of people such as natural capital, human capital, physical capital, financial capital, and social capital (*DFID, 2001*).

According to Stephen A. Hansen and Justin W. VanFleet, indigenous knowledge is traditional knowledge. It is the information that people in a given community, based on

⁴ Hung Nhan commune, Hung Nguyen district, Nghe An province; Yen Ho commune, Duc Tho district, Ha Tinh province; Vo Ninh commune, Quang Ninh district, Quang Ninh province.

experience and adaptation to local culture and environment, have developed over time and that continues to develop. This knowledge is used to sustain the community and culture of the community, as well as to preserve the biological resources necessary for the continued survival of the community. Traditional knowledge usually includes the mental inventories of local biological resources, animal breeds, and local plant, crop, and tree species. It may include information such as which trees and plants grow well together and which are “indicator plants”, for example plants that show soil salinity or are known to flower at the beginning of the rains. Traditional knowledge also includes practices and technologies, such as seed treatment and storage methods and tools used for planting and harvesting (*Stephen A. Hansen and Justin W. VanFleet, 2003*)

Indigenous knowledge is considered as the actual knowledge of the people that reflects the experiences based on traditions and includes more recent experiences with modern technologies. Indigenous knowledge is the local knowledge - knowledge that is special to a given culture or society. It contrasts with the international knowledge system generated by universities, research institutions and private farms. It is the basis for decision making at local level in agriculture, health care, food preparation, education, natural-resource management and a variety of other activities in rural communities. Indigenous knowledge is the systematic body of knowledge that local people acquired through the accumulation of experiences, informal tests, and deep understanding of the environment in a specific culture (*Ashok Das Gupta, 2012*).

Indigenous knowledge is defined as institutionalized local knowledge that was built upon words and transfer from person/one generation to the other by word of mouth. It is the basis for decision-making at local level in many rural communities. Indigenous knowledge is valuable not only for the culture in which it evolves, but also for scientists and planners striving to improve conditions in rural localities. The knowledge set is influenced by the previous generations’ observations and experiences and provides an inherent connection to regions and surrounding environment. Therefore, indigenous knowledge is transferable and provides relationships that connect people directly to the environments and the changes that occur within it, including climate change (*E. N. Ajani, R. N. Mgbenka and M. N. Okeke, 2013*).

Climate change refers to any change in climate over time. That may be caused by the change of nature or as a result of human activities. Climate change is the ability of the natural system to adjust and the ability of people to respond to the stimuli of actual or expected climate or what their impact in order to alleviate the harm or take full advantage of beneficial opportunities (*IPCC, 2007:6*). Throughout human history, any social communities basically have adaptive capacity. There are many situations in the past where local communities have used traditional techniques to deal with the changes of climate and similar risks. In order to adapt to climate change, individuals and communities must be required change their habits, which may be required to change the rules of the sector of agricultural production activities. The lack of decision-making mechanisms with the participation and responsibility can increase socio-economic risks and limit adaptive capacity of communities and societies (*K. Adebayo et al., 2011:8*). Indigenous knowledge in climate change adaptation is the application of indigenous knowledge to adjust the life activities of local communities to minimize the negative impacts and optimizing the positive impacts of climate changes.

Said of the role of indigenous knowledge for adaptation to climate changes, “*The Symposium on Climate Change and and Adaptation in Africa*” held in 2011 was confirmed that indigenous and local knowledge should play an important role in preparing their resilience to climate, and can be exploited and be appropriate to ensure to reducing vulnerability of communities to climate changes. This argument was given because is the basis for local-level decision-making in many rural communities. It is valuable not only to the culture in which it developed, but also for scientists and policy makers striving to improve conditions in rural localities. Integrating indigenous knowledge into policies responding to climate changes can lead to the development of effective adaptation strategies that are cost-effective, participatory and sustainable (Robinson and Herbert, 2001).

In the world, the reviews show that there were many studies on indigenous knowledge about weather forecast, for example, local communities and farmers in Africa have developed complex knowledge systems of gathering, prediction, interpretations and decisions related to the weather. For instance, a study in Nigeria showed that farmers are able to use knowledge system on the weather such as rainfall, thunderstorms, windstorms, dry dusty wind, and sunshine to prepare for weather forecast in the near future (Ajibade and Shokemi, 2003).

Local farmers in sub-Saharan Africa have developed several adaptation measures that have enabled them to reduce vulnerability to climate variability and extremes. One important step in reducing the vulnerability of a climatic hazard is the development of an early warning system for the prediction or forecast. There is a wealth of local knowledge based on predicting weather and climate. These systems of climate forecasts have been very helpful to the farmers in managing their vulnerability to a very great extent. Farmers are known to make decisions on cropping patterns based on local predictions of climate and decisions on planting dates based on complex cultural models of weather (E. N. Ajani et al., 2013).

Susan Materer et al (2001) summarized some local knowledge related to weather forecasts in some countries in Africa. Accordingly, climate and weather can be gathered, predicted and interpreted by locally bound observations and experiences, shared, animals, stars, wind patterns, and social events. Bird cries in the Bolivian highlands is a predictor of abundant pasture, if the cry is not heard before August 30th. If the cry is heard earlier than it indicates a year of scarce pasture (Hatch, 1990). Animal behavior is also noted in Lesotho to predict rainfall such as pigs grunting or larks swarming (Pepin, 1996). Constellations are an important indicator of planting dates, harvest times and other decisions related to weather events. In Bolivia a clear, star filled night in May and June is a sign of frost (Hatch, 1990).

In the sector of agriculture, local farmers in sub-Saharan Africa have been known to conserve carbon (C) in soils through the use of zero tilling practices in cultivation, mulching and other soil management techniques. Natural mulches moderate soil temperatures and extremes, suppress diseases and harmful pests and conserve soil moisture. Before the advent of chemical fertilizers, local farmers mostly depended on organic farming, which also is capable of reducing greenhouse gas emissions. The traditional knowledge would help to preserve cultivated land, namely it prevents nutrient and water loss through high organic content and soil covers, thus making soils more

resilient to floods, drought and land degradation. In organic agriculture, soil fertility is maintained mainly through farm internal inputs (organic manures, legume production, crop rotation), severe energy demands and rejection of synthetic fertilizers and plant protection chemicals with less or no use of fossil fuel (*E. N. Ajani et al., 2013*).

3. Increased climate change-induced water disasters are perceived in the North Central region

The water disasters such as hurricanes, floods, heavy rains, droughts, inundation, and salinity intrusion still exist in coastal countries with a tropical climate, monsoon like Vietnam. However, in the context of climate changes, the weather phenomena have also become disobedient to natural rules. In the past, there are an average of about 10-12 tropical storms per year passing through provinces in the North Central region. In the period 2008-2013, consulted local inhabitants showed that the number of hurricanes in the year tends to reduce but the intensity of hurricanes increased sharply. According to a recent study for local people in three provinces of Nghe An, Ha Tinh and Quang Binh, 65.2% of respondents (n = 355) informed that heavy rains appeared far more than the previous year. Previously, monitoring data has been recorded, the period 1981-2007, the average annual rainfall in the North Central region decreased (*Bui Thi Hong Trang, 2013*). Prolonged drought also appeared more (informed by 51.9% of respondents). Salinity intrusion of years before 1990 was only 5km from the sea to the mainland at the door, but now under observation of local people in the region, salinity intrusion has increased and has moved inland up to 20-25 km (*The survey in Hung Nhan district in Nghe An and Quang Ninh district in Quang Binh, 2013*).

4. Indigenous knowledge in weather forecast of inhabitants

In the North Central region, local people usually based on folk experience his ancestors passed down through observation of natural phenomena from plants, animals, insects, changes of the sky, clouds, wind and some other natural phenomena to bring out the weather forecast serve for their life and their production activities. Those experiences are passed from previous generation to next generation by the words of mouth or proverbs, or folk songs.

For sun and rain forecast, people in some localities of North Central region often rely on observing the expression of some other herbs, such as **bermuda grass** [*cỏ gà*], **crinum asiaticum** [*Cây ngải tướng quân*], other name is **water banana trees** [*Cây chuối nước*], **torpedo grass** [*cỏ gừng*] and some fruit trees in home gardens, like **star-fruit trees**, **lemon trees**, ...The information is provided by people from 3 surveyed provinces as follows:

“If a mass of Bermuda grass [cỏ gà] naturally turn from green into white all over, it will be certainly raining”

“If crinum asiaticum (water banana trees) [Cây ngải tướng quân, cây chuối nước] in blossom in the East, it will rain. The flowers start withering and falling off, it rains. When this species of flowers flourishes, it is a signal to predict the heavy rain in the near future”

“The trees of rain lily [hoa tóc tiên] bloom and until start withering or this species of flowers flourishes, the weather is raining. And when these flowers sporadically blossom, the rain will be stop”

“In a year, the bamboo plants or the water banana trees are in blossom, it is predicted that the year will have a lot of rain and the risk of flood likely happens”

“If torpedo grass has three internodes, it will be raining, and if the grass has seven internodes, it is forecasted flood likely happens”

“Some of the trees in the garden in general if they are green and start sprouting up, that mean it is prepared to rain. The lemon or tea trees have new leaves sprouting from the trees, it will be predicted to rain. Or starfruit trees are in bud, it is prepared to rain. Or mango trees have buds appearing, it will have heavy rain”

The animals and insects in natural environment such as **toads, dragonflies, ants, termites, birds**,... as well as the family pets such as **dogs, cats, chickens**, ... are important basis in the common people’s experiences in some localities in the North Central region to forecast sunny and rainy weather.

“Listening the toads grind its teeth or call, it is going to rain”

“The dogs are raised at home, eat grass by chance, it is going to rain”

“If ants move their eggs from low places to high places, it is going to be raining cats and dogs”

“If dogs eat grass or cats eat grass all of a sudden, it is definitely raining. Or while it is raining,if dogs or cats naturally eat grass, the sun begins to appear in the near future”

“Dragonflies fly at low level, it is rainy; dragonflies fly at high level, it is sunny; dragonflies fly at medium level, it is shadowy.”

“Catching a fish from the field and seeing old fish eggs, a heavy rain is going to happen”

“If termites in their mounds fly up by accident, it is going to rain”

“If red ants crawl out of their hole and climb up house walls, it will rain. While the rain is occurring, red ants crawl into their hole, the rain is over”

From the phenomena related to the changes of sky, clouds and wind such as the moon, the rainbow, Laos wind (hot and dry western wind from Laos to the Central of Vietnam),... the people in three provinces in the North Central region also sum up the experience for the weather forecast related to rain or sunshine.

“If yellow clouds appear, the wind will rise; if red clouds appear, it will be rain”

“If the rainbow appears in the South direction, it will warn of drought. And if the rainbow appears from Thanh Mountain, namely the North direction, it is prepared with heavy rain”

“The more Laos wind is, the more the sun is”

“It is said that seeing full moon on fifteenth day of August in the lunar calendar is necessary for growing rice in May. If the moon’s halo occurs, it is predicted the drought, if moon corona appears, the rain is forecasted to happen.”

For typhoon and flood forecast, some kinds of trees such as **water banana trees, torpedo grass, bermuda grass, bamboo**,... and some trees in the garden like **jackfruit tree** ...; some animals such as **gobies** [cá bống], **carps** [cá chép], **red-claw crabs** [con rạm], **hilaranas** [châu chuộc], **toads** [cóc], **frogs** [ếch], **screaming birds (colley)** [chim hét], ... and some insects such as **ants, mason-bees** [tò vò], **bees** ...; and even some phenomena seen and heard in the sky like **thunder, rainbows**, ... with specific signs are considered the basis for predicting the number of storms, floods in a year, large flood or small flood, and when flood gone down by local people in the North Central region.

There are some traditional experiences basing on plants for forecasting hurricanes, floods as below:

“If it has jackfruits growing on the trees at low level like that, inundation will reach that level, and if jackfruits grow on the trees at high level, it will have large inundation in that year”

“If there are a lot of bamboo flowers being in bloom, it will have large flood in the year; or if bamboo sprouts grow to turn to inside of bamboo groves, a large flood is forecasted to happen; and if bamboo sprouts grow to turn to outside of bamboo groves, it is favorable weather conditions”

“The number of internode on the leaves of bermuda grass and torpedo grass is the signal of the number of floods in a year”

“If the internodes on the leaves of reed grass are deep, it will have large flood in a year; If the internodes on the leaves of reed grass are shadow, it will have small flood in a year”

“If the flowers of plume grass are in bloom, the flood and storms are over. If the flowers of plume grass are in bloom early in September or October in Lunar Calendar, it is predicted that there is no flood in that year”

The experience predicting hurricanes, floods bases on animals and insects such as:

“The nests of hilaranas are hung at high position in the tree; flood water is predicted to achieve that position”

“If the nests of ants or some animals living in water such as frogs, hilaranas are hung at high position in the tree, the large flood will certainly occur”

“Catching fishes from the river and seeing its ovaries that are divided into egg compartments separated, the number of those compartments will inform the number of flood in that year. According to the elderly in our village, this year must have five floods, but until now there are three floods happened”

“In June, July, August and September in the Lunar Calendar, toads roar at night and grind their teeth continuously, the heavy rain is predicted to happen and likely lead to flood”

“If the nests of mason-bees are building at high position in the tree, the large flood will certainly occur”

“If mason-bees build their nests at low position in the tree, small floods will occur in that year; in contrast, if their nests are built at high position at the ceiling, large flood will certainly occur”

Local people also observe meteorological phenomena to forecast hurricanes, floods as follows:

“In the rainy season, a clap of thunder appear in the East, to be honest it is in the Northeast, it is a signal to warn flood”

“In February and March, if one rainbow appears, it is forecasted small floods in that year, but if there are two rainbows appearing at the same time, it is forecasted large floods. Two rainbows overlap each other”

For drought, local people in the North Central region hardly based on observations from plants, animals and insects. They usually rely on observable phenomena from the moon in the specific time of the year such as *“it will be drought when the shadow moon appears”*, and the appearance direction of the rainbow to making the forecast.

Experience in forecasting saline water phenomena were also shared by local people. Based on observations rice seedlings, rice in the field turned into yellow or red, or the appearance of many of the Laos wind, or observing the river water turned into blue and very clear, and the glittering surface of water in the river at night like fireflies, or intuitively tasting the water, or seeing a layer of white scum on the dry fields, local people can recognize the river water is saline or not. This is an important basis for them to making decision to pump water or not pump water into the fields to serve agricultural cultivation.

5. Indigenous knowledge responds to climate change-induced water disaster in agriculture

Vietnamese farmers have summed up four key inputs for high yielding crops via the well-known traditional proverb *“first is water, second is fertilizer, third is hardworking and fourth is seedling”*. Besides, it should be noted that North Central Vietnam is usually under threat of natural hazards such as storm, drought or salinity intrusion. Under the context of increasing occurrence of climate changes and unusual weather phenomena, traditional experiences, such as mentioned in this proverb, have been more valuable than ever. Followings are some experiences that local farmers apply to deal with natural disasters caused by climate changes:

+ *Use short-day varieties of rice and vegetable so harvesting time may come before storm and flood season.*

As the result of climate changes, storming season hits Vietnam North Central region sooner than usual. To adapt for this phenomenon, local farmers in some regions in North Central use short and medium-day varieties. As such, they can harvest their crops before flood and storm seasons. In spring season, the previous varieties which require 160 days to maturity now have been replaced by shorter day variety with the long-time to maturity is 120. In summer-autumn season, varieties with 100-120 days to maturity have

been replaced by variety with 90-95 days to maturity. Similarly, short-day varieties of vegetable are now cultivated.

+ Adjust cultivating calendar to ensure the growth of rice and harvesting time is not in storm and flood season

As the matter of increasing number of storms and floods, local farmers in Vietnam North Central region adjusted their cultivating calendar as the adaptation measure of this change. Specifically, in spring farming season, the farmers do not planting at the beginning or ending planting period yet in the middle. They also pump water to more low land areas and plant rice in these areas first. As such, the harvesting time for each planting areas come differently. They may start harvesting at the areas where rice meets its maturity days. This measure may help them avoid more than 70% crop loss caused by flood and storm. In summer-autumn season, they should gather crop before 30th August unless they will suffer crop loss when flood storm season comes.

To areas with salinity intrusion which results to sluggish growth of rice, cultivating calendar is adjusted with earlier planting time. As such, the growth duration of rice is ensured while harvesting time still come before flood and storm season.

+ Cultivate only a crop in a year to give land a rest and avoid crop loss during flood ad storm season

In some areas in North Central region, local farmers only cultivate in spring or summer- autumn and pass winter-spring seasons. The reason here is to give land a rest for renovating and avoiding loss when storm and flood come.

+ Use new rice variety with higher salt tolerance or switch to other varieties resilient to high salinity or waterlogging

To cope with salinity intrusion, local farmers in some North Central areas like Quang Binh and Ha Tinh come to employ new rice variety with higher level of salt tolerance. In Quang Binh province, pennywort can be grown under salinity and waterlogging conditions. In the other end, pennywort has high nutrient and widely been accepted by consumers as a type of food and drink. Local farmers in some lying areas which usually suffer from flood and salinity are cropping pennywort and its product as it is more profitable than rice.

+ Equip more farming instruments to cope with water disasters orextreme climate events

To vegetable, better-off households will buy ethylene net to cover the vegetable fields in order to reduce the effect of rain on their crops. This method also is considered as a type of organic farming technique which yields crop with higher value than traditional farming.

Local farmers obtain knowledge on using farming equipment and instruments during flood and storm season, such as use specialized rubber trousers with boots in flooding season during planting time, and dome made of nylon and bamboo to protect rice seedling from cold instead of using ash as before.

+ Upgrade within-farm channel and canal systems and build open-close calendar of drains according to local weather calendar

Almost regions has upgraded and concreted within-farm canal system and drains. Pumping stations has studied and reviewed weather calendar to adjust open-close schedule of these drains accordingly. At the flooding time, the drains are opened from inside to outside the dykes, and closed at the drying time to prevent salinity intrusion.

6. Conclusions and recommendations

Indigenous knowledge in production is an important human capital of local residents in Vietnam North Central region in coping with ongoing climate changes. With the acceleration of water disaster in terms of quantity, local farmers need to prepare more resources in response to natural hazards. Apart from traditional experience as mentioned in folklores or proverbs, local farmers also observe trees, insects and animals to withdraw weather forecast including sunny, rainy, flood, drought or salinity intrusion. As such, local farmers increase the response capabilities and decrease their vulnerability under climate change-induced water disasters.

In agriculture, the local people living in Vietnam North Central region have utilized both traditional knowledge as well as contemporary experience in coping with natural hazards. Specifically, they apply new varieties, rearrange cultivating calendar, use new farming instrument and upgrade canal and drainage system. In fact, the applications of new varieties are even more beneficial than traditional ones as they are more resistant with flood and salinity.

In the process of applying local knowledge in responding to natural hazards, local farmers have learned and gradually adjusted from inappropriate farming techniques to more effective ones. However, local knowledge now have not been documented and just circulated via word-of-mouth channel. This phenomenon, in fact, is popular in any regions across Vietnam. To utilize the advantage of local knowledge in responding to climate change-induced water disaster, the indigenous knowledge should be studied, documented and disseminated in various forms including leaflets, video tapes or visual graphs, etc. It is advisable that the indigenous knowledge need be integrated into school curriculum or training syllabus to farmers.

Acknowledge: This study was conducted under the support of study project named “Climate Change-Induced Water Disaster and Participatory InformationSystem for Vulnerability Reduction in North Central region, Vietnam (CPIS)”, code 11-P04-VIE.

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