e-ISSN: 2455-667X

Annals of Natural Sciences
(Peer Reviewed and UGC Approved International Journal)
Vol. 3(2), June 2017: 16-26
Journal's URL: http://www.crsdindia.com/ans.html
Email: crsdindia@gmail.com

Annals of Natural Sciences

ORIGINAL ARTICLE

Adaptation of Farm Households to Climate Change in Dry Agro-Climatic Zones of Karnataka

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ABSTRACT

Whatever changes farmers carry out in their farm is of little use, because climate change is global in nature, despite its global characteristic, the opportunities imparted and expenses incurred due to changing climate has been spatially different and also across farm households. The statements are not contradictory, but discern the territorial impacts of a global phenomenon; which often bring forth differentiated adaptations across categories of farmers (heterogeneous group), for the similar stimuli. The range of adaptive behaviors differs between farmers, and also there were different dimensions of maladaptaitons observed in the study. The interest of the present paper lies in documenting and analyzing these different responses by farmers to the same climate stimuli in agriculture via a variety of processes and forms. Many useful distinctions and typologies of adaptations have been proposed in the literature based on certain central core attributes, the study observed that adaptation is all about not-losing present worth, and salvaging economic means of earning, in both Gulbarga and Kolar districts of Karnataka state. However, when the range of responses for change in the climatic variables are observed in the study districts, maladaptations are acquiring the large space, and the barriers and causes for such maladaptive behaviors is discussed, so as to understand the sub-optimal adaptation by certain section of farmers.

Key words: *Adaptation, Barriers, Maladaptation, Typology*

Received: 2nd March 2017, Revised: 16th April 2017, Accepted: 20th April 2017

How to cite this article:
Halanaik B. (2017): Adaptation of Farm Households to Climate Change in Dry Agro-Climatic Zones of Karnataka. Annals of Natural Sciences, Vol. 3[2]: June, 2017: 16-26.

INTRODUCTION

Climate has nonlinear impacts, with spatially differentiated opportunities and expenses (IPCC, 2007; INCCA, 2010; KCCAP, 2011), because at the global level climate change impacting agriculture is projected to be largely negative for especially emerging economies and robust (vigorous) for developed countries (IPCC AR1-AR5). Further, evidences available on tropical agriculture indicate that; climate variability can shift the production function, besides leading to number of distortions in agriculture; which is already strained by inherent systemic (market, polity) challenges. It is pertinent to note here that Indian dry-land agriculture is highly susceptible to precipitation changes; whereas, irrigated agriculture is sensitive to temperature fluctuations (Kumar, 2009; Agarwal, 2008). The ways of overcoming the adverse impacts of climate change, are either through adaptation and/or by mitigation. Efforts towards mitigation mechanisms have evolved to a desired level, with a clear objective of stabilising green house gas concentrations in the atmosphere; however such stated objective does not exist for adaptation (Burton, 2007). There is no formal definition, baseline and measurement ways for adaptation in UNFCCC, and in addition to that, for a majority of the developing countries, climate change continues to remain as a distant and invisible threat with no

due importance given to adaptation as a strategy of addressing climate change impacts. Adaptation studies recognize that, a thorough discussion of dynamic policies has been lacking so far, leaving the field to unproven assertions and commonplace statements (Stern, 2006; Mengistu, 2011; Salau, 2012; Sima, 2015).

Despite persistent obscurity surrounding adaptations, the potential benefits associated with adaptations are recognised, and in internalising the adverse impacts of climate change, adaptations are core constituent, and providing insights and directional flows to climate policy making. Climatic conditions are inherently variable, climate has changed in the past and so will continue to change in the future (Deressa *et al*., 2011), thus adaptation policies designed for addressing climate change must be inclusive to address climatic variability and extremes weather events. There are two spatial dimensions of adaptation i. whatever changes farmers carry out in their farms are of little use, because climate change is global in nature, ii. Despite its global nature the opportunities obtained and expenses incurred have been globally different (IPCC, 2007; INCCA, 2010; KCCAP, 2011). The statement points to territorial impacts of a global phenomenon.

Apart from territorial nature of impacts, given the heterogeneity in regions, and communities, there are varied ways of responding (Kurukulasuriya & Mendelssohn, 2008) to similar stimuli. Thus it is crucial to analyse and evaluate adaptation strategies not only in monetary terms (costs and benefits), but also in terms of equity, efficiency, social acceptance, need and ability to implement (Smit, 2000; IPCC, 2014). Given that climate change impacts tropical agriculture adversely, it is important to explore the ways and means farmers employ, to restore the productive capacity of their firm. In this context, the main focus of this paper is to document and analyse how farmers respond differently to the same climate stimuli in agriculture.

CONCEPTUALISING ADAPTATION

Adapt means to make more suitable or to fit some purpose by altering or modifying. However, adaptation is a very broad concept; the term has specific interpretations in particular disciplines, with origin and development from population biology, evolutionary ecology and structuralism (Alland, 1975; Winterhalder, 1980; Smithers, 1997). Adaptation imparts a tolerant and resilient characteristic in the biological and human systems. Adaptation to climate change means any adjustment, whether passive or reactive, autonomous or anticipatory, planned or experienced (Fankhauser, 1999) typically characterised in ecological, social or economic systems as a response to observed or expected changes in climatic stimuli, in order to overcome the adverse impacts of change, manage losses, and take advantage of new opportunities the immediate environment bestows upon (Burton, 1993; Stakhiv, 1993; IPCC, 2007). Further, adaptability (Watson *et al,* 1996), refers to the degree to which adjustments are possible, despite intangible non-climatic drivers. Adaptation involves perceiving to the changes and transforming those perceptions into adaptation action. The processes/ actions of adaptation can be spontaneous or planned, and can be carried out in response to or in anticipation of changes in weather conditions (IPCC, 2007; Smith, 1997; IPCC, 1996). An adaptation range can be in preparation for, or a resolution to, the impact of climate change and the propensity to adapt is influenced by the characteristics of the system, which are called the determinants of adaptation. In socio-economic systems, adaptation can be managed, because responses are generated out of anticipation (public) and also sovereign (self-governed), unlike biological systems where it is only reactive (Alland, 1975).

CONTEXTUALISING ADAPTATION

Climatic conditions are inherently variable; weather will vary in future just as it is varying today. Change in the mean climatic condition is actually experienced through changes in the nature and frequency of particular yearly conditions, including extremes, and it is to

this variability that; adaptations are made (Smit, *et al,* 2000). Thus, adaptation to climate change necessarily includes adaptation to climate variability. Coping with changes in weather will increase the spill-over cost; while coping with inter-annual variations does not make sense if the climatic change is persistent. Thus, the literature stresses that intent, timing and duration of adaptation action matters (Sohngen, *et al*., 2002; Mendelssohn 2000). If adaptations are done too early, they can cost more with a limited use, and if done too late, climate change related damages may mount, thus leading missed opportunities (Gbetibouo, 2009). Changing capital and long run investment is desirable form a long-term perspective, but may not be effective when it comes to dealing with short-run weather shocks. Thus, there seems to be no perfect bridge between adapting to short-term weather changes and adapting to climate change.

There is an argument that the, best way to prepare for climate change is to adapt to climate variance, i.e., changes in weather conditions from year to year (Smith, *et al*., 1997) and that adaptation is a stock, building up that stock will prepare the system to address changes in climate effectively. Literature on adaptation presents it as a continuous and flexible process (not a static concern) that evolves with changing climate. Thus, adaptation is perhaps best handled via long-term deeper transformations with medium-term coping processes (Berkhout, *et al*., 2009; McGray, *et al*., 2007; Leary, *et al*., 2008; Hallegatte, *et al*., 2009; IPCC, 2012), because adaptation is a given need.

FRAMING OF ADAPTATION

Adjustments as a response to (or in light of) climatic stimuli, evoke differentiated scope, application and interpretations, based on the characteristics of the natural and human systems. For instance, adjustments might take place in respect of climate change, or might allude to change and variability, or just to climate, given the physical and human significance scales. Adaptation can be in response to adverse effects or vulnerabilities, as also in the light of opportunities. Further, it can be in response to past, actual or anticipated conditions, changes or opportunities, indicating that the stimuli (climate), system (agricultural) and transient dimensions influence the adaptation milieu. With a robust evidence and high agreement, IPCC- AR5 report states that, the framing of adaptation has moved from a focus on biophysical vulnerability to the wider socio-economic drivers of vulnerability (Noble, *et al,* 2014), the framework (Smit, *et al*., 1999) proposed for systematically describing and analysing adaptations to climatic stimuli centres around three dimensions, namely i. Adaptation to what (stimuli)- the nature of the disturbance/perturbation; ii. Who or what adapts (unit, sector, activities, systems, structures)– define system of interest; and iii. How does adaptation occur– the process of adapting and the resulting outcome or condition as a result of adaptation? A thorough description of adaptation helps specify the stimuli and whether it is focal, contextual or residual, system of interest, and the processes and forms of occurrence.

TYPOLOGIES IN ADAPTATION

Many useful distinctions and typologies of adaptations to climate change have been proposed. The major contributions come from Smit, *et al.* (1996) and Smithers, and Smit (1997) in their theoretical papers on anatomy of adaptation. Burton, *et al.* (1993), applied adaptation categories from the field of environmental hazards to differentiating adaptation behaviours and the range of responses, such as behaviours of preventing, tolerating and spreading losses, change in use or activity and change in location. Based on the time assumption (temporal spacing) of the stimulus, adaptive strategies are grouped by Stakhiv (1993), as long range, medium-term and tactical (immediate), and also contingent and/or analytical. Different adaptive measures are provided by Carter *et al* (1994), based on the forms adaptations take on such as structural or infrastructural, legal and legislative, institutional and administrative, organizational and regulatory, educational, research and development, and technological change. Whereas on the other

hand, based on the functions the adaptations perform, Bijlsma, *et al.* (1996), classified adaptations into retreat, accommodative or protective categories. Smithers and Smit (1997a) explained adaptation based on the criteria of intent or purposefulness, the spatial and social scale, timing, duration, form and effect. Further, socio-economic adaptive responses can be summarized broadly based on the central attributes considered in the literature, namely, cognition, role of government, transformational structures involved (Smithers, *et al,* 1997; Smit, *et al.* 2000).

CORE CRITERIA FOLLOWED IN CLASSIFYING ADAPTATIONS

There are core criteria to classify and analyse adaptations based on temporal spacing, duration involved, the intent, social and spatial scale, adaptation actors (public and private), function/effect, the analytical combinations, ancillary effects and public good, change in use/activity, cohesion and thrift, and perception regarding change in the climate and its impact on the livelihoods.

Action or inaction that may lead to an increased risk of adverse climate-related outcomes, increased vulnerability to climate change, or diminished welfare, now or in the future is identified as maladaptation. The dimensions of maladaptation which include actions that emit increased GHGs, disproportionately burden the most vulnerable, involve high opportunity costs, and reduce incentives and capacity to adapt to set oaths that limit future choices (IPCC, 2014; Barnett and O'Neill, 2010). Adaptation deficit is the resultant gap between the current state of a given system and a state that would minimize the adverse impacts of climate variability and change (Burton, *et al.*, 2002; Burton, 2004; Burton and May, 2004; Parry, *et al.*, 2005).

METHODOLOGY AND STUDY AREA

The operational definition of adaptation relates to all those responses/reactions to climate change that are designed to escape current losses/costs in the short run and inform the emergency of decision making for timely adaptation in the long run. The adaptations have been considered to three broad climatic conditions listed below, because a climatic stimulus is both contextual and residual in the present paper-

1. Changes in means or climate norms over long period of time
2. Inter-annual or decadal variability
3. Isolated extreme weather events (catastrophic conditions– excess and violent rains, heavy winds and storms, heat waves and prolonged dry spell, drought).

As mentioned earlier, important objective of the paper is to find out the adaptation practices of 304 sample farm households, from Gulbarga and Kolar districts (two different agro-climatic zones) of Karnataka. A household was defined as people living in one compound and conduce food, any labour or income to the unit (Change and Chapling, 1997; Census, 2011; Osbahr, *et al,* 2008; Singh, 2016). In order to address these objectives; questionnaire in the study had collected information on a number of factors that could be considered as driving the adaptation actions of the farmers. These factors were identified, based on existing literature and field exploration, then applied the logit regression to study the relationship between adaptation actions and their drivers, thus twenty two different logit regressions were run, after taking into account the hypothesized relation between each independent and dependent variables.

Farmers were asked if they had responded to the changing climate, and if so, what are the types of adaptation measures and how different are the forms and processes were involved in undertaking adjustments by the different categories of farm households is documented. However, in the study area farmers reported as having employed a range of multiple adaptation actions as part of dealing with climate variability, with the adaptations overlapping and informing each other. In each case, logit regression results were used for calculating the odds ratios which reveal the relationship between

independent and dependent variables (adaptation actions). The resultant typology with respect to farmers' category is presented in Table 1.

Table 1: The Range of Adaptation Actions Practised by Different Categories of Farmers and the Resultant Typology

Adaptation Strategies	Marginal	Small	Semi-medium	Medium	Large	Adaptation typology
Altered sowing timings Early/ delayed sowing of principal crops of the region to match with change in monsoon prospects	40.0	26.2	19.5	6.9	7.5	Reactive adaptation and protective function by preventing risk, leverage scope of reactive action
Disposal of inventories Disposal of assets, dispossessing inventories, distress sale of liquid assets even before the hardship occurs	35.8	42.4	18.4	1.7	1.7	Accept loss, perceived illegitimacy and Myopia (time)-thinking short-term "Not-dying" and salvage livelihoods
Intensification Increased use of inputs, chemicals and resources per unit area, investing high on digging bore wells and on irrigation	3.8	17.6	19.4	27.2	32.0	High opportunity cost Reduce losses, high operational costs, diminishing rate of returns and maladjustment
Shift in the type of farming Lease and tenant farming, share and rent farming on pre-agreed terms of exchange of output irrespective of the quantity of output	26.2	25.3	20.6	17.7	10.2	Chang in use/activity
Use of different crop variety and crop rotation High yielding varieties, short duration crops to buffer against perturbations	43.6	19.0	6.9	10.1	20.5	Accommodative Change in activity Buffer system against perturbations– accommodative and stability enhancer Incremental adjustment-short-lived
High density cropping Densely spaced cropping to avoid crankiness of top soil due to high temperatures, and retain moisture	15.4	16.9	10.3	33.7	23.7	Competitive Restore and prevent losses
Build traditional water harvesting structures building farm ponds, step wells, lift irrigation wells and pooling resources with community	37.2	29.0	15.2	4.5	14.1	Pre-conceived, time-honoured, external adaptation with ancillary benefits Type I adaptation
Borrowing credit, curtail consumption of food in the household and underfeed the livestock Borrow money from informal credit sources at irrational rate of interest, with high social cost , limited range of action, relatively quick and often temporary measure	30.7	17.5	32.7	13.7	5.4	Relatively quick and often temporary response with high social cost, incompetence and poor fit : maladjustment
Decline in non-productive expenses Declined socio-cultural expenditures, Suspension of expenditures on non-productive purposes, cultural purposes, ceremonies, village charitable and social events	33.1	28.7	21.8	10.0	6.4	Ancillary benefits and reduced cost of coordination across multiple beneficiaries (community) Change in activity, cohesiveness and parsimony within group
Occupational diversity and obility Livelihoods need to be two to three folds wider than household size, thus off-agricultural jobs for survival, show demonstrated goodness of fit. Spatially mobilising livestock to water-fodder regions is also a common practice.	33.0	28.7	24.5	9.6	4.3	External adaptation Change in behaviour, demonstrated goodness of fit Fine-tuning response, time-tested , shared co-benefits High cost of coordination across multiple beneficiaries (Community) while mobilizing livestock.
Mortgage and sale of land Fallowing of productive land, decline in the area of production , leaving productive land fallow and in extreme cases sale of land by the farm households	1.2	7.4	17.7	40.2	33.5	Paths limiting future income choices-privation Recoup – under/over adapt Land is incidental to maintaining livelihood and it is a Rapid uni-directional change

Table 2: The Dimensions of Maladaptations which occur due to Different Barriers in Decision Making

Farmers category	Trend	Barriers to decision making	Maladaptive actions	Causes
Marginal and small farmers	Vulnerability continuum	High transaction costs and adjustment costs	Asset stripping, curtailed consumption, dispossession of inventories, declined socio-cultural expenditures, pledging of social identity	Inequity and unsustainability
Semi-medium farmers	Eventual failures	High opportunity costs and information asymmetry	Inappropriate risk taking, Indebtedness for unproductive reasons Reduced capacity and future incentives Axing trees in the field	Myopia (space)
Medium and Large farmers	Under / Over adaptation	Hyperbolic discounting	Time discounting by acting too soon or too vigorously - fallowing and sale of land Creation of long-term and long-distance risk by one's own action. Contributing to climate change by increased GHGs emission due to intensification of agriculture, axing trees etc.,	Callosity and unrealistic expectations from adjustments

RESULTS AND DISCUSSION

Adaptations should be a device to administer impacts, which are designed primarily for preventing the crop and livestock loss (ex-post-facto) in the current and restore productive capacity in the successive years. When poor germination of seeds and crop yield reduction are foreseen as a result of delayed onset of monsoon, altered sowing operations like early or delayed sowing, short duration varieties and different crop varieties are opted by marginal (40 percent), small (27 percent) and semi-medium (20 percent) farm households, a reactive strategy leverage the scope of reactive responses.

Perhaps medium (27 percent) and large (32 percent) farm households show minimal analytical combination, while administering the impact in current period, because, in the current period, core operations are supplemented by subsistence activities by households which incur more losses and induce diminishing returns. For instance, intensification of agricultural activities increases the opportunity cost and operating cost due to irrational use of inputs over fixed unit of land. Agricultural intensification and application of more factors of production does not necessarily lead to increasing returns, according to the law of diminishing marginal returns in the theory of production.

An alternative which marginal and small farmers choose in times of weather extremes and resources scarcity is to migrate to another location (mobility of people and livestock) or change the basic pattern of earning (occupational diversification). Intensity of climate change at which a coping system may no longer be viable, farmers either opt for change in activity or will be change the type of farming. Increase in the occupation diversity of a farmer is an indication that the total amount of time invested in farming is declining, and the probability of diversifying the occupation is high with dry land marginal (33 percent) and small farmers (29 percent), because how many people are affected depends on where they are located, and shifting the occupation from agriculture to non-agriculture will reduce sensitivity of the household to climate change, and this is how farmers without irrigation are compelled to reach out to the wider economy. The probability of borrowing money decreases with increase in the number of dependents in the households due to contributions of human capital, also marginal and small farmers out-migrate by pledging social identity (voter card, MNREGA job card, public distribution cards) for advance money, on the terms of not returning to village before the next agricultural season.

MALADAPTATION

Behaviours which conform to an adaptive fit in terms of the environmental niche will be rewarded and those which are maladaptive will eventually have to be extinguished (Alland, 1975), maladaptations are acquiring the large space due to economic barriers, farmers range of responses to changes in climate, but in a sub-optimal way is leading to maladaptations. In designing purposeful adaptation, maladaptations are an increasing

cause of concern to adaptation planners, where intervention in one location or sector could increase the vulnerability of another or increase the vulnerability of the target group to future climate changes. Maladaptation arises not only from inadvertent badly planned adaptation actions, but also from deliberate decisions where wider considerations place greater emphasis on short-term outcomes ahead of long-term threats, or that discount, or fail to consider, the full range of interactions arising from the planned actions. Such deliberate actions are a resultant of denied entitlements for few, and discounting the time for many. Indeed IPCC (AR5) reports show that, maladpatation is a possibility, if evaluations are not comprehensive enough i.e., an evaluation approach must address management of institutional processes and players, and must propose net benefits and implementabilty as central criteria while evaluating (Smith & Lenhart 1996) it. The maladaptations observed in the study are driven largely due to non-climatic forces, which serve short-term goals, with high social costs (Smithers, *et al,* 1997) and lead to hostile polity.

Large and medium farmers adapted by reducing the opportunity cost of labour, but incurred explicit costs due to agricultural intensification, such as HYVs (native crops possess wide ranging thresholds), short duration crops and densely spaced crops, because of weather insurance, which in literature is also called as moral hazard.

DIMENSIONS OF MALADAPTATION

When the adaptation actions employed by the framers were subject to analysis, the basic concern is to check how adaptive the existing responses to climate variability are in the present and also in the long-term? The adaptation responses were less strengthening the existing livelihoods and the shortcomings are due to information asymmetry and inadequacy of present information on adaptation, thus resulting in multiple marginal adaptations. The oscillation of marginal and small farmers 'in and out of vulnerability' (Singh, 2016) in the susceptible path is due to their inability to reduce the transactions cost arising out of insufficient information acquisition and inability to adjust to the new climates. The economic cost of adaptation is not a decussate of projected cost of climate change impacts at a particular point in time and poor farmers are retaining conventional distress responses; signalling distress that are no longer appropriate in the present context and this disproportionate burdening (Barnett and O'Neill, 2010) of the most vulnerable is leading towards intensifying vulnerability. Lack of land records with marginal and small farmers (78 percent) set paths which limit adaptation incentives and future income choices, since they are made to sell land within the village, because of their inability to overcome transaction costs relating to land market information and acquisition.

Adapting actions that under-rate the local relationships and take risks inappropriately due to uncertainties in climate projections coupled with socio-economic development deficit pathways, climate policies neutrality, reaction of asset reign to changes in climate, is leading semi-medium farmers to adjust under the circumstances of eventual failures (IPCC, 2014), unintentionally. Semi-medium farmers are not-adapting to address wider climate change impacts on their livelihoods; instead there is creation of negative externality (non-excludable and free rider nature of natural resources) due to irrational axing off trees in the field, intensive use of depleting underground water.

Whereas medium and large farmers tend to possess hyperbolic discounting by setting paths that limit future choices and contribute to GHGs emissions, due to intensification in agriculture, digging bore wells more deeply, where there is spill over costs, which to be borne by neighbouring farms. According to geo-hydrology, digging deeper does not yield more water, perhaps increases the missed opportunities due to limited income and hampers the capacity to adapt. The inadequate and immediate problem solving nature of wealthy farmers incur ancillary effects and encourage maladaptations in other farm households.

Wealthy farmers are creating long-term and long-distance risks, by temporally discounting actions which are either too soon or too vigorous, due to narrow conceptualisation of value and scope of adaptation, whereas poor farmers are attempting to escape from the present occupation and switch to non-agricultural livelihoods.

The temporal and contextual sequence of responses by farmers, during a distress year, shows that current consumption is curtailed first and recourse to devices, such as sale of assets, mortgage of land, suspension of socio-cultural expenditures and migration (the conventional signals of distress). Mobility takes place at a later stage during a scarcity year when, in the absence of relief etc, the distress becomes more severe. The expected utility out of change in location by spatially mobilising the livestock also increases, soon, with the beginning of dry spell, because keeping animals in resource scarce region would exceed the return to interest. This strategy helps in spreading the loss and imparts flexibility, in the contingent period; thereby safety margin is widespread, despite marginal rains and underperforming climatic conditions.

SUMMARY AND CONCLUSIONS

Whether farmers will succeed in reducing the negative impacts of climate change through adaptation is analysed by considering the typology of adaptations in the present study. Internal adaptation favouring homogeneity and external adaptation favouring variation is seen in the wake of annual changes in weather, but it is preposterous to attribute to mere one type of adaptation. There is a little evidence to decipher that, there is no adaptation or there is full adaptation sought by farmers. Adaptation has occurred as a matter of course, thus adaptations must be comprehended as spontaneous, accommodating and an evolving process.

Farmers' are obliged to strive for socio-political safety and land is incidental to maintaining livelihood, especially in less mobile societies like farmers. Since farmers are located and committed to particular resource use, farmers use a variety of adaptive devices to discount the losses and gain co-benefits. Farmers attribute lower weights to long term adaptations through hyperbolic discounting and show myopia (time and space), due to economic barriers in decision making. Keeping in mind the end goal to markdown (discount) on substantial social cost, marginal and small farmers forefend disintegration of households, family units and livestock, and adapt by change in activity and location. Also they singled out to decline on unproductive expenses, diminution of cultural and social events, accordingly diminishing losses. The underlying reason for such dismayed responses is attributed to the emergency in agriculture; because such high population dependency and pressure on land, is probably unknown in any other parts of the world except in Indian milieu. Semi-medium farmers, settle on non-institutional credit sources, while medium agriculturists' intensify agriculture, by contingent and technical adjustments, and the temporal scope of adaptations by large farmers is concurrent i.e., instantaneous. Large farmers have uncertainties for adaptation due to problematic behaviours due to Myopia (time) thinking short term, whereas marginal farmers have myopia (space) thinking locally due to inadequate asset base i.e., inequity, lack of organizational capacity at any/all scales, institutional failure, incompetence/poor fit and /or perceived illegitimacy.

In the process of not losing the productive capacity, farmers deliberately attempt more vulnerable adjustments, adaptations must reduce the sensitivity and, alter the exposure of the system by increasing the ability to recoup to its original state; perhaps inherited adaptations will tend to propagate in its new and modified form; thereby not informing one another. Systems which have limited response ranges to changing environment will tend to be replaced by more flexible systems, at least in variable environments.

Farmers' societies are technologically primitive and climatic problems have created an unsatisfactory situation in agriculture, causing wicked difficulties, and non-agricultural adaptations, where farmers are opting for something more vulnerable than ever.

Adaptation in ethnographic studies is seen as the ability of a system to return to a previous state when conditions permit. Adaptations in agricultural systems are seen as too rapid unidirectional change, often creating maladaptive behaviours more so often. Farmers are very closely, but unequally linked to each other, and have restricted range of adaptation to climate change within their operating framework. It is erroneous to presume that, adaptation has been independently employed, perhaps it is an unconscious, much diffused correlation of climatic and non-climatic drivers thus might lead to both co-adaptation and also no-adaptation.

The adjustment processes must be effective, and complementary to the farmer's own efforts, but it is a rare phenomenon, there is an appalling necessity to address both types I and type II adaptation in a polity and equity framework. National polity and plan of action on climate change have shown ineptness, objectivity and apathy, and on the top of it policy pressurises limited land for intensification of agriculture and promotes over-exploitation of natural resources, and ignites social unrest. Adaptation environments are not appearing as strengthening but it can be made available if the barriers in adaptive decision making are removed or reconstructed.

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