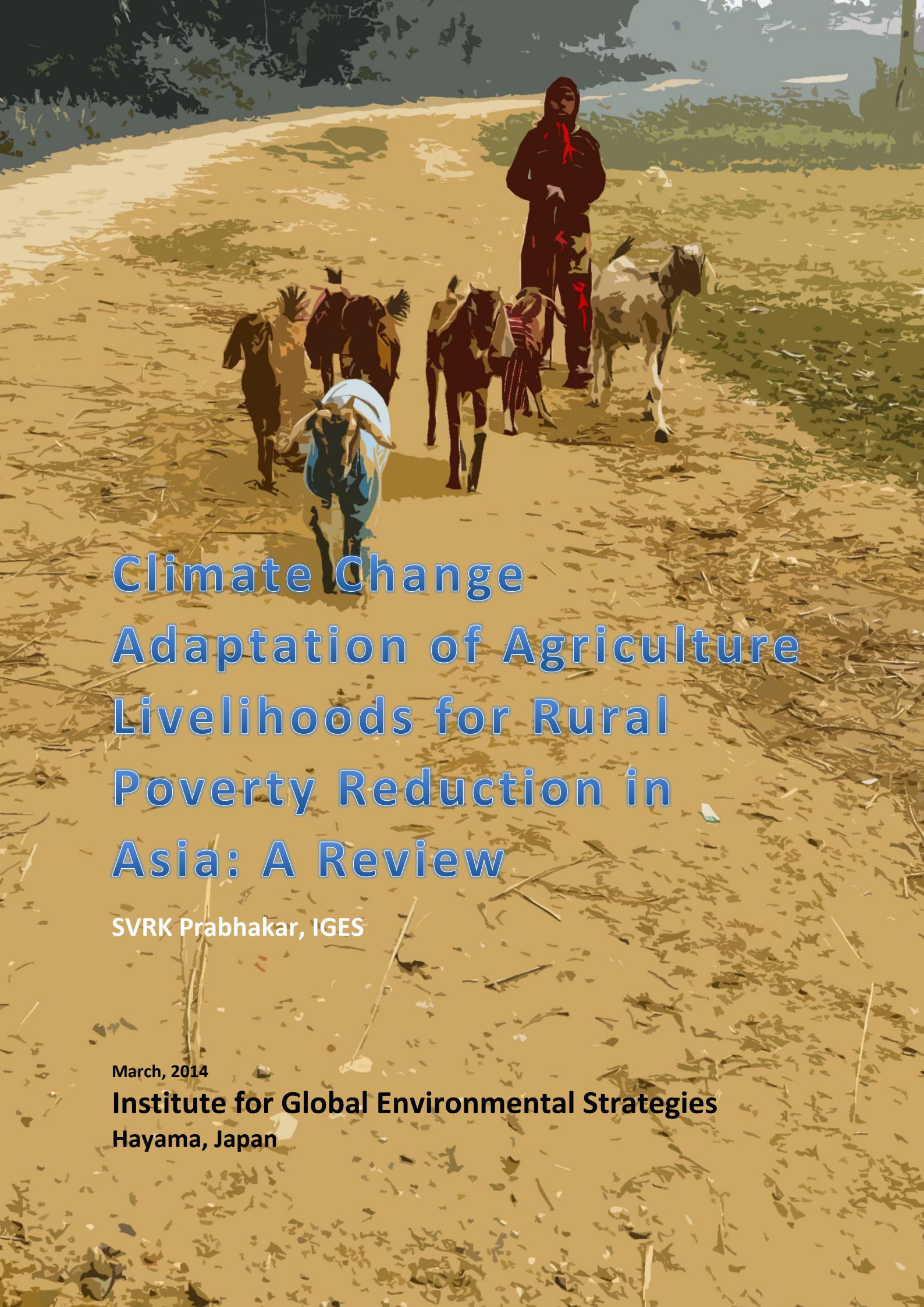

Climate Change Adaptation of Agriculture Livelihoods for Rural Poverty Reduction in Asia: A Review

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CLIMATE CHANGE ADAPTATION OF AGRICULTURE LIVELIHOODS FOR RURAL POVERTY REDUCTION IN ASIA: A REVIEW

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Abbreviations

ADB	Asia Development Bank
APAN	Asia Pacific Adaptation Network
CBA	Community based adaptation
CCA	Climate change adaptation
GDP	Gross Domestic Product
IFRC	International Federation of Red Cross and Red Crescent Societies
IGES	Institute for Global Environmental Strategies
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention on Climate Change

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Climate Change Adaptation of Agriculture Livelihoods for Rural Poverty Reduction in Asia: A Review

Summary

Climate change will have significant impact on rural livelihoods and poverty undermining the developmental gains made by countries in Asia, as is evident from the literature reviewed. The review suggests that these impacts will vary widely from region to region and communities within a region and country depending on the existing vulnerability and preparedness. While several evidences could be found for livelihood impacts of climatic variability, the same is not true in case of identifying and differentiating impacts of climate change from variability. There is a clear dearth of literature in areas of projected livelihood impacts and poverty implications at regional, national and sub-national scales. The literature is even scantier when it comes to assessing projected impacts for specific sub-sections of society such as rural land less labourers and those secondary livelihoods dependent on agriculture sector. Several adaptation practices have been suggested in the published literature largely aiming at stabilizing livelihoods with largely qualitative attribution for adaptation effectiveness in terms of livelihoods and poverty reduction. Approaches such as community based adaptation, livelihood and economic diversification, providing access rights to natural resources and migration has gained prominence. There is a clear dearth of literature employing tools for assessing quantitative livelihood and poverty reduction benefits of adaptation practices on the ground.

Introduction

Livelihood is a means of making a living. It encompasses people's capabilities, assets, income and activities required to secure the necessities of life (IFRC, 2014). Livelihood activities are what we do to make a living every day! From livelihoods point of view, Asia is predominantly an agrarian society as is evident from 58% of its total population living in rural areas out of which 81.8% are dependent on agriculture for their livelihoods (FAOSTAT, 2011). In addition, agriculture employs 24.7% of total population in these countries and contributes to 15.3% of total value added GDP (FAOSTAT, 2011; The World Bank, 2011a). It clearly indicates that agriculture is an important livelihood for not only the economic value it contributes to the total GDP but also in terms of number of people engaged in agriculture. The heavy dependence of large proportion of population on agriculture and natural resource based livelihoods has been attributed to one of the reasons behind the prevailing poverty in Asia. With climate change impacts becoming prominent, these natural resource dependent communities are disproportionately impacted necessitating a need to identify and implement adaptation strategies.

Keeping the above background in view, this working paper aims to present a review of the current literature on agriculture livelihoods and rural poverty in Asia and identify suitable adaptation measures suggested from literature. Literature search was carried out with specific key words using several academic databases but not limiting to Academic Search Complete, Web of Science, GreenFILE, JSTORCAB Abstracts, AGRICOLA, AGRIS, ScienceDirect, Google Scholar etc. The literature published after 2005 were included in the review.

Rural poverty and link with agriculture

Nearly 20% of total population earns less than 1.25 USD a day in Asia (The World Bank, 2008). The rural poverty is even more severe in Asia with greatest number of rural poor living in South Asia (IFAD, 2010). Asia also has largest number of hungry people in the world with high proportion in rural areas. In countries such as Bangladesh, there is significant proportion of population that falls under the category of chronic poverty, those who earn 0.5 USD or less per day (Braun et. al., 2009). In terms of inequality, as expressed by Gini Index, available data from countries in Asia show considerable diversity with Malaysia (Gini

Index 46.2) was being the most in-equal and Afghanistan (Gini Index 27.8) being most equal (The World Bank, 2008). An empirical research carried out in 20 countries of Asia and Africa indicated that the poverty in these regions is perpetuated and characterized by social exclusion, living in remote areas with poor access to education, health and credit facilities, poor education, and few assets to depend (Ahmed et al., 2009). The high incidence of rural poverty and hunger is closely related to the heavy dependence of these populations on natural resources that are directly influenced by changes in weather and climate, and seems to indicate a close connection between rural livelihoods and poverty (IFAD, 2010; Haggblade et al., 2010).

The close link between rural poverty and agriculture as livelihoods has been clearly established. This is indicated through Asia having high levels of rural poverty compared to the urban poverty, with relatively higher poverty incidence in the 8 least developing countries in the region (FAOSTAT, 2011). Though the Asia has emerged as an economic power during recent decades, there is still a considerable gap in progress in developmental indicators when compared to rest of the world (The World Bank, 2011b). In terms of developmental indicators, Southeast Asia is the third poorest region in the world after Sub-Saharan Africa and Southern Asia, and ranks poorly in terms of labor productivity, access to food, maternal health, and forestation (United Nations, 2009). Consequently, as large proportion of rural population dependent on agriculture, agriculture has been identified as a key driver of economic growth in the region (The World Bank, 2007).

However, Asia has made significant improvement in poverty eradication over the past decade (The World Bank, 2008). At the sub-regional level, the East Asia has recorded much rapid reduction in poverty followed by South Asia (IFAD, 2010). Significant part of this reduction has come from population shift, rapid growth in agriculture, and urban contribution (Janvry and Sadoulet, 2010). There have been significant changes in terms of livelihood diversification in Asia over the decades due to rapid economic development. Estimates suggest that currently about 51% of total income in rural Asia come from non-farm sources (Haggblade et al., 2010; Haggblade et al., 2009), out of which major proportion comes from local non-farm business and employment. There has also been steady growth in the proportion of remittances contributing to rural income (Estudillo and Otsuka, 2010).

Climate change impacts

There is very sparse published literature on past and projected future impacts of climate change on livelihoods and poverty. In general, the available literature suggest that unmitigated climate change impacts in the future could result in significant impact on the regions prospects for sustained development in terms of income generation, food security and poverty reduction (ADB, 2009). One could gain a good understanding of livelihood impacts from the past climatic events such as droughts (Harshita, 2013; Selvaraju et al., 2006), floods (Nuorteva et al., 2010; Dun, 2011; Nguyen, 2007; Keskinen et al., 2010) and typhoons (Huigen and Jens, 2006; Gaillard et al., 2007; Uy et al., 2011). The past droughts have severely impacted the rural livelihoods with disproportionate impact on small farmers, wage labours agriculture labours and small business man (Selvaraju et al., 2006) who also have least access to rural safety net mechanisms including financial services (Wiggins and Hazell, 2008), notwithstanding the recent developments in microfinance services in parts of Asia. The past floods have exposed the conditions such as lack of access to alternative livelihoods, difficulty in maintaining existing livelihoods, triggering independent households and debt situation of households leading to migration in the Mekong region (Dun, 2011). Similar impacts of repeated floods leading to perpetual vulnerability were found in Tonle Sap Lake area of Cambodia (Nuorteva et al., 2010; Keskinen et al., 2010). Adverse impact of typhoons on livelihoods has been mainly through damage to various livelihood assets of coastal populations in Philippines and the level of ownership of livelihood assets has been a major determinant of livelihood vulnerability to typhoons (Uy et al., 2011).

Climate change will not have uniform impact on a population within a country but rather depends on location, socio-economic conditions and level of preparedness (Begam et.al, 2011). A review study undertaken by the Asian Development Bank has indicated significant economic costs due to climate change impacts mostly on agrarian and related sectors in the East Asia. The negative impacts are pronounced after 2050 due to severe negative impacts on rice production, the principle and staple food crop grown in this region. These negative impacts on agriculture productivity would have significant impact on the aggregated household welfare, livelihoods and poverty in the region (Zhai and Zhuang, 2009).

Climatic variability and change is known to impact livelihoods and poverty which include poor being disproportionately impacted by global change phenomenon, there is an increasing tendency of migration due to climate change induced loss of livelihoods and instances of farmers leaving farming and leaving farms fallow due to repeated droughts and loss of crops, increasing reliance on non-farm sources of income due to increasing loss of crops and related income (Table 1). This suggests that migration has become one of the strategies to sustain livelihoods in the wake of climate and environmental change (Barnett and Webber, 2010). The shift towards non-farm income activities, including migration, appears to be more prominent in countries and communities with least access to land (Winters et al., 2009) and in those communities with better access to education (Estudillo and Otsuka, 2010). Rapid-onset environmental change such as floods, as in the case of Mekong Delta, are increasingly playing role in migration (Warner, 2010). These migration induced remittances have significantly contributed to Asian economies and decreased the poverty gap but had negligible effect on poverty rate (Vargas-Silva et al., 2009). Please refer to the later sub-section for a focused discussion on migration as an adaptation option.

Some of the projected impacts are presented in Table 2. Rural poverty in parts of Asia could be exacerbated (Skoufias et al., 2011b) due to negative climate change impacts on the rice crop and increase in food price and cost of living with important implications for rural livelihood and poverty (Hertel et al., 2010; Rosegrant, 2011). Poverty impacts of climate change would be heterogeneous among countries and social groups. In a low crop productivity scenario, food producers in the food exporting countries, such as Indonesia, the Philippines and Thailand, would benefit from climate change related global food price rises and be able to reduce poverty, while countries such as Bangladesh would experience a net increase in poverty of 15% by 2030 (Hertel et al., 2010). These impacts could be different within food exporting countries with disproportionate negative impact of climate change induced food price rise on farm labour and urban poor. Regression studies conducted by Skoufias et al. (2011a) indicated significant negative impacts of shortfall in rainfall on the welfare of rice farmers in Indonesia, compared to the delay in onset of rainfall. These impacts may lead to global mass migration and related conflicts (Laczko and Aghazarm, 2009; Barnett and Webber, 2010; Warner, 2010; The World Bank, 2010b).

TABLE 1 OBSERVED IMPACT FROM CLIMATE CHANGE ON LIVELIHOODS AND POVERTY IN ASIA

Observed change / Impact	Country/ Region	References
Poor are disproportionately impacted by climate related hazards	East and South Asia	Kim, 2011
Increased migration due to environmental (e.g. rapid onset disasters), social and economic reasons	Mekong region	Warner, 2010; Black et al., 2011
Leave farming due to repeated droughts	South Asia	Kulkarni and Rao, 2008
Loss of crops, income and fallows	Cambodia	Nguyen et al., 2009

Source: Compiled by author

TABLE 2: PROJECTED IMPACTS FOR LIVELIHOODS AND POVERTY IN ASIA

Projected Impacts	Country/Region	Projection Details	References
Negative impact on rice crop, increase in food price and cost of living, increased poverty	Asia	GTAP Model, projections for 2030, scenarios: Impacts resulting low, medium and high productivity	Hertel et al., 2010
Loss of livelihoods to indigenous people from declining alpine biodiversity	Tibet/Himalayas	Qualitative observations	Salick et al., 2009; Xu et al., 2009
Significant decline in crop yields of rice (25%) and wheat (40%) with resultant impacts on livelihoods	Asia	Climate impact projections for 2050	Knox et al., 2011

Source: Compiled by author

Key vulnerabilities

Agriculture livelihoods are made vulnerable to climate change due to several predominant predisposing factors which vary widely within the region. One of the important factors to be considered while evaluating the past impacts of climate change on agriculture livelihoods is the play of several factors that have made the region's agriculture less sustainable which include input non-responsive yields, soil erosion, natural calamities and water and land quality related problems (Dev, 2011). While these factors have predisposed the Asia region's

agriculture related livelihoods to climate change, rural livelihoods are more severely impacted than the urban ones due to the predominantly agricultural population and the poor are more vulnerable to livelihood loss. It is evident that the rural areas are largely excluded from economic growth story that has been emerging in Asia. The clear indicators are, to begin with, high levels of rural poverty compared to the urban poverty, with relatively higher poverty incidence in the least developing countries in the region (FAOSTAT, 2011). Other factors include burgeoning small holding and peasant farmers with growing population and nucleus family structure dividing the landholding size, large areas under rain-fed agriculture, poor infrastructure development and poor access to markets and land use changes including increasing deforestation and resultant decline in ecosystem services.

However, specific key vulnerabilities of livelihoods to climate change in various river basins in Asia arise from unsustainable water source and dense population with high dependence on agriculture (Indus-Ganges basin), inherently low precipitation (Karkheh basin), and high population combined with intensive irrigated agriculture (Yellow River) (Mulligan et al., 2011). Allison et al. (2009) has indicated the high vulnerability of fisheries based livelihoods in four tropical Asian countries (Bangladesh, Cambodia, Pakistan and Yemen) to climate change impacts due to the combined effects of predicted warming, importance of fisheries to national economies and diets and limited capacity to adapt to potential impacts. In India, farmers cultivating winter maize for their livelihoods are more vulnerable than those cultivating winter wheat (Knox et al., 2011). In the arid central Asia, the key vulnerabilities to climate and environmental change appears to be physical geography which is dominated by deserts, relative underdevelopment due to focus on monoculture agricultural exports, and social, economic, institutional upheavals (Lioubimtseva and Henebry, 2009).

The livelihoods of indigenous people in Himalayas and Tibet are known to be vulnerable to climate change impacts (Byg and Salick, 2009; Salick, 2009; Salick et al., 2009; Xu et al., 2009) but there are *limited* empirical studies focusing on this subject. The limited access to land and forest resources has also appeared as key vulnerabilities in the literature (Winters et al., 2009; United Nations, 2009). In Batangas province of Philippines, lack of irrigation facilities, lack of access to markets, and higher production and marketing costs were identified as key vulnerabilities impacting rural livelihoods (Acosta-Michlik and Espaldon, 2008). Among social

groups, urban wage labourers were found to be most vulnerable to cost of living related poverty impacts of climate change than those who directly depend on agriculture for their livelihoods (Hertel et al., 2010). This is particularly interesting since the impact of climate change is not only felt on the yield, which is an income to farmers, but also on food prices. Hence, the impact on producers is relatively neutralized than those who spend considerable proportion of their income on food.

Adaptation options

In essence, climate change adaptation (CCA) has mostly been about creating climate resilient livelihoods that help creating a bundle of capitals (natural, physical, human, financial and social capital) and bringing people out of poverty (Table 3). In general, greater emphasis on agriculture growth has been suggested as an effective means of reducing rural poverty (Janvry and Sadoulet, 2010; Rosegrant, 2011). Bundled approaches are known to facilitate better adaptation than individual adaptation options (Acosta-Michlik and Espaldon, 2008; Fleischer et al., 2011). Significant amount of literature has stressed for the greater role of local communities in decision making (Alauddin and Quiggin, 2008) and in prioritization of adaptation options (Prabhakar et al., 2010; Prabhakar and Srinivasan, 2011; Prabhakar, 2014). Community-based approaches have been suggested to identify adaptation options that address poverty and livelihoods, as these techniques help capture information at the grassroots (Huq and Reid, 2007; Aalst et al., 2008), and help integration of disaster risk reduction, development, and climate change adaptation (Heltberg et al., 2010), connect local communities and outsiders (Aalst et al., 2008), address the location-specific nature of adaptation (Iwasaki et al., 2009; Rosegrant, 2011), help facilitate community learning process (Bass and Ramasamy, 2008), and help design location specific solutions (Ensor and Berger, 2009). Some groups can become more vulnerable to changes after being 'locked into' specialized livelihood patterns as shown in the case of fish farmers in India (Coulthard, 2008). Migration has received prominent attention in the literature as an adaptation option (Reuveny, 2007; Warner, 2010). For this importance, a dedicated sub-section has been provided below addressing the migration related issues.

There has also been emphasis on forests and their management for providing resilient livelihoods and reduce poverty (Persha et al., 2010; Larson, 2011; Noordwijk, 2010; Chhatre and Agrawal, 2009). This is particularly important for securing rights to resources has been found essential for greater livelihood benefits to the poor indigenous and traditional people (Macchi et al., 2008) for which REDD+ schemes have been urged to respect and promote community forest tenure rights (Angelsen et al., 2009). It was suggested that indigenous people can provide a bridge between biodiversity protection and CCA (Salick, 2009) which appears to be missing in the current discourse on ecosystems based adaptation. However, there are arguments against REDD+ supporting poverty reduction due to its inability to promote productive use of forests, which may keep communities in perpetual poverty (Campbell, 2009). On the contrary, there is a contrasting view that REDD+ can also work in forests managed for timber production (Putz et al., 2012; Guariguata et al. 2007) especially when strategies such as reduced impact logging to maintain ecosystems is practiced (Guariguata et al. 2007) and implementing other approaches such as assuring the legality of forest products, certifying responsible management, and devolving control over forests to empowered local communities (Putz et al., 2012).

Available literature also suggests the need for identifying and promoting technologies and policy options that will provide both mitigation potential as well as sustained income generation potential in a changed climate (Bhandari et al., 2007; Rosenzweig and Tubiello, 2007; Paul et al., 2009;). Interesting examples seem to emerge on how some practices provide completely unexpected livelihood benefits which otherwise may not be captured in standard evaluation frameworks, as in the case of introduction of traditional flood mitigation measures in China could positively impact the local livelihoods leading to both reductions of physical and economic vulnerabilities of communities (Xu et al., 2009).

TABLE 3 ADAPTATION OPTIONS FOR RURAL LIVELIHOODS AND POVERTY IN ASIA

Issues	Region	Adaptation strategies	Benefits/ Co-Benefits	References
Delay and shortfall in rainfall	Indonesia	Access to credit and public works project	Able to protect food expenditure in the face of weather shocks	Skoufias et al., 2011b
General (droughts , floods	General	Weather index insurance, cattle insurance, seed banks,	Poverty cantered adaptation, creation of assets and access to	Barrett et al., 2007; Tanner and

Issues	Region	Adaptation strategies	Benefits/ Co-Benefits	References
etc)		credit facilities, assisted migration, cash for work	resources	Mitchel, 2008; Jarvis et al., 2011
General	General	Assisted migration	Build financial, social and human capital	Barnett and Webber, 2010
General	Vietnam	Yield growth and improving agriculture labour productivity	Rural poverty reduction, livelihood diversification	Janvry and Sadoulet, 2010
Droughts and floods	Philippines	Bundling of improved varieties and agronomic practices and combination of production and market support	Economic benefits and social learning	Acosta-Michlik and Espaldon, 2008
General	Asia	Community based adaptation (CBA)	Capture information at the grassroots, help integrating disaster risk reduction, development, and CCA, connect local communities and outsiders, and addresses the location specific nature of adaptation.	Aalst et al., 2008; Heltberg et al., 2010; Rosegrant, 2011
General	Asia	Forest management	Resilient livelihoods, buffer from shocks	Chhatre and Agrawal, 2009
General	Asia	Securing rights to resources, community forest tenure rights	Resilient livelihood benefits to the poor indigenous and traditional people	Macchi et al., 2008; Angelsen et al., 2009
Biodiversity loss	Tibet	Greater involvement of traditional and indigenous people in CCA decision making	Indigenous knowledge from the years of living in close harmony with nature	Byg and Salick, 2009; Salick et al., 2009

Source: Compiled by author

Defining adequate community property rights, including solving the issues such as land tenure, reducing income disparity, exploring market based and diversified off-farm

livelihood options, moving from production based approaches to productivity and efficiency decision making based approaches, and promoting integrated decision making approaches were suggested (Brouwer et al., 2007; Paul et al., 2009; Niino, 2011; Stucki and Smith, 2011). There is considerable stress in the literature on low cost options and the need for scaling up of the same, considering the vast majority of population living below poverty line in some of the least developed countries such as Bangladesh (Iwasaki et al., 2009; Rawlani and Sovacool, 2011). Greater understanding is required on linkages between local livelihoods, ecosystem functions, and land resources for creating positive impact on local livelihoods and poverty reduction in areas with greater dependency on natural resources (Paul et al., 2009). Keeping in view the interconnected nature of the problems across geographical , social and political scales, an emphasis on increased regional collaboration in scientific research and policy making was suggested for reducing climate change impacts on water, biodiversity and livelihoods in Himalayan region (Xu et al., 2009).

Livelihood diversification, including diversification of livelihood assets and skills, has appeared as one of the prominent suggestions for buffering climate change impacts on certain kinds of livelihoods (Selvaraju et al., 2006; Nguyen, 2007; Agrawal and Perrin, 2008; Wiggins and Hazell, 2008; Keskinen et al., 2010; Uy et al., 2011). The diversification should occur across assets including in productive assets, consumption strategies and employment opportunities (Agrawal and Perrin, 2008). A similar effect could be achieved by diversification of varieties through cultivation of multiple crop varieties could in turn help increase genetic diversity which is an important element of ecosystems based adaptation (UNFCCC, 2012). As such, ecosystems based adaptation has been advised as one of the important tools for adaptation planners to secure people livelihoods in the face of climate change (Jones et al., 2012). The ecosystems based adaptation entails integrates the use of biodiversity and ecosystem services into an overall strategy to help people adapt to climate change (IUCN, 2009). The ecosystem-based adaptation is known to help especially those populations that directly depend on biodiversity and ecosystem services for their livelihoods. These include farmers, agro-pastoralists and fishermen. The strategy includes livelihood diversification by designing activities dependent on well-managed natural resources while reducing the dependency on fragile and vulnerable ecosystems (IUCN, 2009).

Akin to the livelihood diversification at the local level, economic diversification at the macro level has been identified as one of the important strategies to reduce countries vulnerability to climate change due to high dependency on sectors such as agriculture, tourism, fisheries, forestry and energy production (UNFCCC, 2014). In a synthesis report on economics of climate change by the World Bank (2010a), the lack of economic diversification was considered as one of the important sensitivity factors to climate change impacts. While agreeing that economic diversification can protect communities from adverse impacts of climate change and food price volatility, CARE cautions that the economic diversification need not always be the solution and that the interventions be thoroughly assessed for their multiple benefits and that the actors engaged in adaptation should be able to inculcate dynamic planning compatible with ecological characteristics (Ambani and Nicholles, 2012).

A greater understanding of various existing policy processes in place/specific geographic context, their compatibilities and non-compatibilities, should also be understood. For example, interventions to increase livelihood options through conservation initiatives that may restrict the access to natural resources for the very people that rely upon these resources for their living might make them more vulnerable or eventually tourism may be limited to areas that are less vulnerable restricting the expansion of tourism (Roman and McEvoy, 20110).

Migration and livelihoods

Migration deserves specific attention in the discourse related to livelihoods since most migration is result of in search for securing alternative livelihoods as the livelihoods are impacted by some shocks related to climate and or economic in nature. There is an emerging body of literature suggesting growing nexus between migration and climate change (IOM, 2008; Piguet et al., 2011). The global report of IDMC (2011) enlists climate related natural hazards such as floods and droughts as some of predominant causes for internal displacement. In 2010 alone, 38.8 million people were internally displaced 85% of them were due to hydrological hazards and 77% of displacements took place in Asia alone. Rapid-onset environmental changes such as floods are increasingly playing a role in migration in the case of Mekong Delta (Warner, 2010). Some of these migrants often return to the vulnerable areas for reconstructing their houses (Piguet, 2008) which is a cause of

concern including due to issues such as ownership and rights of use (Norwegian Refugee Council, 2008).

Migration has also received attention in the literature as an adaptation option (Reuveny, 2007; Warner, 2010; ADB, 2012; The Government Office for Science, 2011). The IPCC 5th Assessment Report gave significant focus on this subject indicating that migration could be a major adaptation strategy that enhances human security with literature suggesting high agreement with medium level of evidence. While some forms of environmentally induced migration may be adaptive, other forms of environmental migration may indicate a failure of social-ecological systems to adapt (Warner, 2010), suggesting need for differentiating the root cause of migration and treating them through new forms of governance that connects the migrants with those who returned and remained.

Migration has become one of the strategies to sustain livelihoods in the wake of climate and environmental change (Barnett and Webber, 2010). The shift towards non-farm income activities, including migration, appears to be more prominent in countries and communities with least access to land (Winters et al., 2009) and in those communities with better access to education (Estudillo and Otsuka, 2010). The increasing migration has led to increasing migration-induced remittances contributing to Asian economies and decreased the poverty gap, but had negligible effect on the poverty rate (Vargas-Silva et al., 2009).

However, migration could have negative impacts on the migrants as observed in the case of Bangladesh where migrant workers had to live and work under poor conditions such as crowded shelters, poor sanitation, conflict and competition with local population, and exploitation (Penning-Rowsell et al., 2011). Though forced migration can result from implementing some adaptation options such as construction of dams, the negative outcome from these migrations could be overcome by putting in place proper safeguards (The Government Office for Science, 2011). Managed retreat of coastal communities has also been suggested to as a response to projected sea level rise (Alexander et al., 2011).

While migration is a relatively well understood phenomenon, understanding different causal factors leading to migration are still being looked into. Studying environment and other natural resources-induced migration can help to effectively manage climate change induced

migration (Reuveny, 2007). There is a need for deeper understanding on migration induced by slow-onset disasters such as droughts (IDMC, 2011) for the reasons that the migration patterns are complex, spread across relatively long time scales, combines complex responses that couldn't be clearly differentiated, and inability to determine aspects such as where and for how long (The Government Office for Science, 2011).

ADB (2012) suggests that lack of understanding on underlying uncertainties related to migration shouldn't be the cause of inaction but that the migration should be addressed proactively through policy, projects and financing at all levels of government. The most favourable approach is to deal with migration within a development framework and by incorporating into adaptation strategies (ADB, 2012 and The Government Office for Science, 2011). Only such inclusive approach would make difference in whether climate induced migration would emerge as forced displacement or planned and facilitated adaptation strategy.

Role of epistemic communities

The importance of various institutions in achieving CCA in specific and sustainable development in general has been well recognized by various international conventions such as processes under UNFCCC and the Commission on Sustainable Development. Institutions play catalytic role in bridging gaps and linking opportunities with needs so that the agenda of CCA is fulfilled to its fullest extent (UNFCCC, 2007). However, there are systemic barriers that make these institutions less than ideal in delivering the expected deliverables by them. For example, the Paris Declaration on Aid Effectiveness (Paris Declaration on Aid Effectiveness, 2005) has identified the weaknesses with many partner institutions to implement result driven development strategies, accountability, and transparency. Similar concerns appear to be the reason behind the slow progress in Millennium Development Goals (United Nations, 2010). These institutional limitations would also effect the adaptation activities since adaptation activities would also have to be financed and managed by the same institutions in most national circumstances. The survey conducted by Prabhakar and Nakata (2014) on loss and damage indicated that lack of coordination among local governments is a major bottleneck in addressing CCA related issues and that networks could play a major role in bridging the gaps especially in capacity building.

In order to overcome some of these barriers, various international (e.g. UNEP Adaptation Network), regional (e.g. APAN), and thematic networks (e.g. University Network for Climate and Ecosystems Adaptation Research of UNU, and Ecosystems and Livelihoods Adaptation Network of International Union for Conservation of Agriculture) have come into existence (APAN, 2011; UNU, 2011; IUCN, 2011). These networks have the agenda of promoting collaborative research and understanding on CCA and link various stakeholders with the opportunities that exist to promote adaptation. Though these networks are largely successful in bringing together various stakeholders and sharing the information across boundaries, their effectiveness in addressing overarching barriers such as limited funds for adaptation (Srinivasan and Al-Amin, 2010) and means to measure progress in adaptation (Prabhakar et al., 2010) have been limited.

Substantive discussions on institutional arrangements for promoting adaptation could be observed under the Conference of Parties (Prabhakar and Srinivasan, 2009). The establishment of Adaptation Fund Board has been one important step in accelerating adaptation actions in resource constrained and highly vulnerable countries (Adaptation Fund, 2011). Nationally, few countries in Asia have established institutional mechanisms to govern adaptation. Notable to mention are the National Council on Climate Change and Indonesia Climate Change Trust Fund by Indonesia, climate change resilience fund by Bangladesh, Prime Minister's Council on Climate Change by India, and National Leading Group to Address Climate Change and Clean Development Mechanism Fund by China. For these efforts to become more meaningful, it is important that these measures are well connected to the base at which adaptation takes place. Most institutions suffer from this limitation since they tend to focus on higher strata of stakeholders leaving communities at the end of the pipeline (Prabhakar and Nakata, 2014). With this limitation, making real impact on local livelihoods is a challenge.

Conclusion

It can be concluded from the above discussion that the climate change will have significant impacts on agriculture livelihoods and rural poverty necessitating urgent actions to alleviate the possible suffering. In the wake of climate change, what is necessary is to make

livelihoods sustainable (IFRC, 2014), resilient and robust (Pain and Simon, 2012). Sustainable so that while addressing the livelihood problems of today the livelihood opportunities and environment handed down to the future generations should not be compromised. Resilient livelihoods are important especially to buffer the short term shocks and perturbations from climate change so that communities will be able to maintain stable livelihoods during the shocks. Robustness will enable communities to be able to act before too late and especially relevant in case of slow on set hazards such as sea level rise, saline water intrusion, droughts and loss of biodiversity and ecosystem services against which communities would have to continuously change with the changing baseline. For this to happen, there is a need for creating a bundle of capitals (natural, social, physical, human and financial capital) and certainly bring people out of poverty. The vast past experience suggest that GDP growth from agriculture will have four times impact on poverty reduction than GDP from non-agriculture sectors. Despite this, the rate of investment in agriculture research and development has been steadily declining in most developing and economies in transition. Indigenous and traditional communities are the most neglected communities along the development continuum and there is a need that they get the greater share of pie in the growth story. The best known approach to secure the development is by securing rights to resources which is essential for resilient livelihood benefits to the poor indigenous and traditional people. While several adaptation practices are discussed in this paper, noteworthy is to mention the low-risk liquidity options such as microfinance programs and risk transfer products that can help lift rural poor from the poverty by providing buffer from shocks. While migration has been seen as a sensitive issue, we should not ignore the importance of managed migration that could be critical for areas with limited livelihood options and areas that have reached limits to adapt. Relocating communities with their consent and proper mechanisms in place could prove to be an effective strategy in locations where adaptation is not possible for the available means and benefits of planned relocation outweigh the benefits of in-situ adaptation. However, for this to happen, there is a need for proper decision making mechanisms so that governments and other stakeholders could resolve the sensitivities amicably. Currently there exists no such mechanism. One of the ideas for this mechanism to come in place is to identify areas that may have already reached limits to adaptation and put in place policy and institutional support mechanisms to identify

alternative areas for relocation and re-settlement with necessary due consultation processes in place.

References

Aalst, M.K., T. Cannon, and I. Burton, 2008: Community level adaptation to climate change: The potential role of participatory community risk assessment. Global Environmental Change, 18: 165-179.

Acosta-Michlik, L. and V. Espaldon, 2008: Assessing vulnerability of selected farming communities in the Philippines based on a behavioural model of agent's adaptation to global environmental change. Global Environmental Change, 18: 554-563.

Adaptation Fund, 2011: Adaptation Fund established by the Parties to the Kyoto Protocol of the UN Framework Convention on Climate Change. [Accessed 17 June 2011 at http://www.adaptation-fund.org].

ADB, 2009: The Economics of Climate Change in Southeast Asia: A Regional Review. Manila, Philippines: Asian Development Bank.

ADB, 2012: Addressing Climate Change and Migration in Asia and the Pacific. Manila, Philippines: Asian Development Bank, 82 pp.

Agrawal, A. and N. Pern, 2008: Climate Adaptation, Local Institutions and Rural Livelihoods. IFPRI Working Paper W08I-6. School of Natural Resources and Environment. Michigan, USA: University of Michigan.

Ahmed, A.U., R.V.Hill, L.C.Smith, and T. Frankenberger, 2009. The poorest and hungry: Characteristics and causes. In Braun, C., R.V. Hill, and R. Pandya-Lorch (eds.) The Poorest and Hungry: Assessments, Analyses, and Actions. Washington D.C., USA: International Food Policy Research Institute, p 107-116.

Alauddin, M. and J. Quiggin, 2008: Agricultural intensification, irrigation and the environment in South Asia: Issues and policy options. Ecological Economics, 65 (1), 111-124.

Alexander, K.S., A. Ryan and T.G. Measham, 2011: Managed Retreat of Coastal Communities: Understanding Responses to Projected Sea Level Rise. Australia: CSIRO.

Allison, E.H., A.L. Perry, M. Badjeck, W.N.Adger, K. Brown, D. Conway, A.S. Hills, G.M. Pilling, J.D. Reynolds, N.L. Andrew, and N.K. Dulvey, 2009: Vulnerability of national economies to the impacts of climate change on fisheries. Fish and Fisheries, 10:173-196.

Ambani, M. and N. Nicholles, 2012: Why community based adaptation makes economic sense. CARE Policy Brief, July 2012. London, UK: CARE.

Angelsen, A., M. Brockhus, M. Kanninen, E. Sills, W.D. Sunderlin, and S. Wertz-Kanounnikoff, 2009: Realizing REDD+: National strategy and policy options. CIFOR, 362 pp.

APAN, 2011: Climate Change Adaptation in Asia and the Pacific. [Accessed 17 June 2011 at http://www.asiapacificadapt.net/].

Barnett, J. R. and M. Webber, 2010: Accommodating migration to promote adaptation to climate change. The World Bank Policy Research Working Paper No 5270, 62pp.

Barrett, C. B., B.J. Barnett, M.R. Carter, S. Chantarat, J.W. Hansen, A.G. Mude, D.E. Osgood, J.R. Skees, C.G. Turvey, and M.N. Ward, 2007: Poverty traps and climate and weather risk: Limitations and opportunities of index-based risk financing. IRI Technical Report 07–03.

Bass, S. and S. Ramasamy, 2008: Community Based Adaptation in Action: A case study from Bangladesh. Rome, Italy: Food and Agriculture Organization.

Begam, R.A., C. Siwar, R.D.Z.R.Z. Abidin, and J.J. Pereira, 2011. Vulnerability to climate change and hardcore poverty in Malaysia. Journal of Environmental Science and Technology, 4(2): 112-117.

Bhandari, P.M., S. Bhadwal and U. Kelkar, 2007: Examining adaptation and mitigation opportunities in the context of the integrated watershed management programme of the Government of India. Mitigation Adaptation Strategies for Global Change, 12:919–933.

Black, R., W.N. Adger, N. W. Arnell, S. Dercon, A. Geddes, D.S.G. Thomas, 2011: The effect of environmental change on human migration. Global Environmental Change, 21S: S3-S11.

Braun, C., R.V. Hill, and R. Pandya-Lorch, 2009: The Poorest and Hungry: Assessments, Analyses, and Actions. Washington D.C., USA: International Food Policy Research Institute, 584pp.

Byg, A. and J. Salick, 2009: Local perspectives on a global phenomenon—Climate change in Eastern Tibetan villages. Global Environmental Change, 19: 156-166.

Campbell, B.M., 2009: Beyond Copenhagen: REDD+, agriculture, adaptation strategies and poverty. Global Environmental Change, 19: 397-399.

Chhatre, A. and A. Agrawal, 2009: Trade-offs and synergies between carbon storage and livelihood benefits from forest communities. Proceedings of the National Academy of Sciences of the United States of America, 106: 17667-17670.

Dev, M.S., 2011: Climate change, rural livelihoods and agriculture (Focus on food security: in Asia-Pacific region. WP 2011-014. Mumbai, India: Indira Gandhi Institute of Development Research.

Dun, O., 2011: Migration and displacement triggered by floods in the Mekong delta. International Migration, 49: e200-e223.

Ensor, J. and R. Berger, 2009: Understanding Climate Change Adaptation: Lessons from Community-Based Approaches. Practical Action, UK.

Estudillo, J.P. and K. Otsuka, 2010: Rural poverty and income dynamics in Southeast Asia. Handbook of Agricultural Economics, 4: 3434-3468.

FAOSTAT, 2011: FAOSTAT. [Accessed 28.05.2011 at http://faostat.fao.org/faostat].

Fleischer, A., R. Mendelsohn, and A. Dinar, 2011: Building agricultural technologies to adapt to climate change. Technological Forecasting and Social Change, 75: 982-990.

Guariguata, M.R., J.P. Cornelius, B. Locatelli, and C. Forner, 2007: Mitigation needs adaptation: Tropical forestry and climate change. Mitigation and Adaptation Strategies for Global Climate Change, 13: 793-808.

Haggblade, S., P. Hazell and T. Reardon, 2009: Transforming the rural nonfarm economy: Opportunities and threats in the developing world. IFPRI Issue Brief 58. Washington D.C., USA: International Food Policy Research Institute.

Haggblade, S., P. Hazell and T. Reardon, 2010: The rural non-farm economy: Prospects for growth and poverty reduction. World Development, 38: 1429-1441.

Harshita, T., 2013: Impact of drought on rice based agriculture economy- A case study of livelihood security in rural areas of Sultanpur District of Uttar Pradesh. Voice of Intellectual Man-An International Journal, 3(1): 137-148.

Heltberg, R., H. Gitay and R. Prabhu, 2010: Community-based adaptation: Lessons from the development marketplace 2009 on adaptation to climate change. Social Development Working Paper No 122.

Hertel, T.W., M.B. Burke, and D.B. Lobell, 2010: The poverty implications of climate-induced crop yield changes by 2030. Global Environmental Change, 20: 577-582.

Huigen, M.G.A. and I.C. Jens, 2006: Socio-economic impact of super typhoon Harurot in San Mariano, Isabela, the Philippines. World Development, 34(12): 2116-2136.

Huq, S. and H. Reid, 2007: Community Based Adaptation: A Vital Approach to the Threat Climate Change Poses to the Poor. IIED Briefing, UK: International Institute for Environment and Development.

IDMC, 2011: Displacement due to Natural Hazard Induced Disasters, Switzerland: Internal Displacement Monitoring Center and Norwegian Refugee Council, 29 pp.

IFAD, 2010: Rural Poverty Report 2011: New Reality, New Challenges, New Opportunities for Tomorrow's generation. Rome, Italy: International Fund for Agricultural Development, 317 pp.

IFRC, 2014: International Red Cross and Red Crescent Societies. [Accessed 25 March 2014: https://www.ifrc.org/en/what-we-do/disaster-management/from-crisis-to-recovery/what-is-a-livelihood/].

IOM, 2008: Migration and Climate Change. IOM Migration Research Series, Geneva, Switzerland: International Organization for Migration.

IUCN, 2009: Ecosystem-based Adaptation: A Natural Response to Climate Change. Switzerland: International Union for Conservation of Nature.

IUCN, 2011: Ecosystems and Livelihoods Adaptation Network, Switzerland: International Union for Conservation of Nature. Accessed on 17 June 2011 at http://www.elanadapt.net/.

Iwasaki, S., B. H. N. Razafindrabe, and R. Shaw, 2009: Fishery livelihoods and adaptation to climate change: a case study of Chilika lagoon, India. Mitigation Adaptation Strategies for Global Change, 14 (4): 339-355.

Janvry, A. and E. Sadoulet, 2010: Agricultural growth and poverty reduction: Additional evidence. The World Bank Research Observer, 25: 1-20.

Jarvis, A., C. Lau, S. Cook, E. Wollenberg, J. Hansen, O. Bonilla, and A. Challinor, 2011: An integrated adaptation and mitigation framework for developing agricultural research: Synergies and tradeoffs. Experimental Agriculture, 47: 185-203.

Jones, H.P., D.G. Hole and E.S. Zavaleta, 2012: Harnessing nature to help people adapt to climate change. Nature Climate Change 2: 504-509.

Keskinen, M., S. Chinvanno, M. Kummu, P. Nuorteva, A. Snidvongs, O. Varis and K. Vastila, 2010: Climate change and water resources in the lower Mekong river basin: Putting adaptation into context. Journal of Water and Climate Change, 1 (2): 103-117.

Kim, 2011: How much more exposed are the poor to natural disasters? Global and regional measurement. Disasters, 36: 195-211.

Knox, J.W., T.M. Hess, A. Daccache, and M. P. Ortola, 2011: What are the projected impacts of climate change on food crop productivity in Africa and South Asia? Canfield University, DFID Systematic Review, 71pp.

Kulkarni, S. and N. Rao, 2008: Gender and drought in South Asia: Dominant constructions and alternate positions. In J. Jairath and V. Ballah, Droughts and Integrated Water Resource Management in South Asia, p 70-97.

Laczko, F. and C. Aghazarm, 2009: Migration, environment and climate change: Assessing the evidence. 441pp.

Larson, A.M., 2011: Forest tenure reform in the age of climate change: Lessons for REDD+. Global Environmental Change, 21: 540-549.

Lioubimtseva, E., and G.M. Henebry, 2009: Climate and environmental change in arid Central Asia: Impacts, vulnerability, and adaptations. Journal of Arid Environments, 73: 963–977.

Macchi, M., G. Oviedo, S. Gotheil, K. Cross, A. Boedhihartono, C. Wolfangel, and M. Howell, 2008: Indigenous and Traditional Peoples and Climate Change. Gland, Switzerland: International Union for Conservation of Nature.

Mulligan, M., M. Fisher, B. Sharma, Z.X. Xu, C. Ringler, G. Mahe, A. Jarvis, J. Ramirez, J.C. Clanet, A. Ogilvie, and M. Ahmad, 2011: The nature and impact of climate change in the Challenge Program on Water and Food (CPWF) basins. Water International, 36: 96-124.

Nguyen, H., S.V.R.K. Prabhakar, and R. Shaw, 2009: Adaptive drought risk reduction in Cambodia: Reality, perceptions and strategies. Environmental Hazards, 245-262.

Nguyen, H.N., 2007: Floods in Mekong River Delta, Viet Nam. Occasional Paper. Human Development Report 2007/2008: Fighting Climate Change: Human Solidarity in a Changing World. New York, USA: United Nations Development Program.

Niino, Y., 2011: Options on land management and land use for coping with climate change in South Asia. In: Climate Change and Food Security In South Asia, R. Lal, M. V.K.

Sivakumar, S.M.A. Faiz, A.H.M.M. Rahman and K. R. Islam, Eds., Springer, New York, 277-294.

Noordwijk, M., 2010: Climate Change, Biodiversity, Livelihoods, and Sustainability in Southeast Asia. In P.E. Sajise, M.V.Ticsay, and G. C. Saguigut (Eds.), Moving Forward: Southeast Asia Perspectives on Climate Change and Biodiversity, Singapore: ISEAS/SEARCA, 259pp.

Norwegian Refugee Council, 2008: Future Floods of Refugees: A Comment on Climate Change, Conflict and Forced Migration. Olso, Norway: Norwegian Refugee Council.

Nuorteva, P., M. Keskinen, and O. Varis, 2010: Water, livelihoods and climate change adaptation in the Tonle Sap Lake area, Cambodia: learning from the past to understand the future. Journal of Water and Climate Change, 1:87-101.

Pain, A. and S. Levine, 2012: A conceptual analysis of livelihoods and resilience: Addressing the insecurity of agency. HPG Working Paper 2012. London, UK: Overseas Development Institute.

Paris Declaration on Aid Effectiveness, 2005: Paris Declaration on Aid Effectiveness: Ownership, harmonization, alignment, results, and mutual accountability. [Accessed 17 June 2011 at www.adb.org/media/articles/2005/7033_international_community_aid/paris_declaration.pdf].

Paul, H., A. Ernsting, S. Semino, S. Gura and A. Lorch, 2009: Agriculture and climate change: Real problems, false solutions. Report published for the Conference of the Parties, COP15, of the United Nations Framework Convention on Climate Change in Copenhagen, December 2009. [Accessed 10.05.2011 at www.fao.org/fileadmin/user_upload/rome2007/docs/agriculture-climate-change-june-2009.pdf].

Penning-Rowsell, E., P. Sultana and P. Thompson, 2011: Migration and Global Environmental Change. CS4: Population movement in response to climate related hazards in

Bangladesh: the 'last resort'. Foresight Report, London, United Kingdom: Government Office for Science, 37 pp.

Persha, L., H. Fischer, A. Chhatre, A. Agrawal, and C. Benson, 2010: Biodiversity conversion and livelihoods in human-dominated landscapes: Forest commons in South Asia. Biological Conservation, 143: 2918-2925.

Piguet, E, 2008: Climate Change and Forced Migration, UNHCR Research Paper No. 153. Geneva, Switzerland: UN High Commission for Refugees.

Piguet, E., A. Pécoud, P. Guchteneire, 2011: Migration and Climate Change, Paris, France: Cambridge University Press and UNESCO Publishing, 464 pp.

Prabhakar, S.V.R.K. and A. Srinivasan, 2009: Financing and Governing Adaptation and Promoting Disaster Risk Reduction. Hayama, Japan: Institute for Global Environmental Strategies. [Accessed 17 June 2011 at http://enviroscope.iges.or.jp/modules/envirolib/view.php?docid=1856].

Prabhakar, S.V.R.K. and A. Srinivasan, 2011: Metrics for mainstreaming adaptation in agriculture sector. In: Climate Change and Food Security In South Asia, R. Lal, M. V.K. Sivakumar, S.M.A. Faiz, A.H.M.M. Rahman and K. R. Islam, Eds., New York, USA: Springer, 551-568.

Prabhakar, S.V.R.K. and M. Nakata, 2014: Loss and damage and climate change adaptation: Stakeholder perceptions for shaping the future agenda of Asia Pacific adaptation network. IGES Research Report, Hayama, Japan: Institute for Global Environmental Strategies.

Prabhakar, S.V.R.K., 2014: Adaptation decision making frameworks and tools: Multi-criteria decision making tools for prioritizing adaptation actions at community level. IGES Research Report, Hayama, Japan: Institute for Global Environmental Strategies.

Prabhakar, S.V.R.K., T. Kobashi, and A. Srinivasan, 2010: Monitoring Progress of Adaptation to Climate Change: The Use of adaptation metrics. Asian Journal of Environment and Disaster Management, 2 (3): 435-442.

Putz, F.E., P.A.Zuidema, T. Synnott, M. Pena-Carlos, M. A, Pinard, D. Sheil, J.K. Vanclay, P. Sist, S. Gourlet-Fleury, B. Griscom, J. Palmer, and R.Zagt, 2012: Sustaining conservation values in selectively logged tropical forests: The attained and the attainable. Conservation Letters, 5 (4): 296-303.

Rawlani, A. K. and B.K. Sovacool, 2011: Building responsiveness to climate change through community based adaptation in Bangladesh. Mitigation and Adaptation Strategies for Global Change, DOI: 10.1007/s11027-011-9298-6.

Reuveny, R., 2007: Climate change-induced migration and violent conflict. Political Geography, 26: 656-673.

Roman, C. and D. McEvoy, 2010: Kailash Sacred Landscape Conservation (KSLC) Strengthening Project – Nepal: Tourism and Climate Change. Final Report, Melbourne, Australia: RMIT University.

Rosegrant, M., 2011: Impacts of climate change on food security and livelihoods. In M. Solh and M.C. Saxena (eds), Proceedings of an International Conference on Food Security and Climate Change In Dry Areas, 1-4 February 2010, Amman, Jordan, ICARDA, 24-26.

Rosenzweig, C. and F. N. Tubiello, 2007: Adaptation and mitigation strategies in agriculture: an analysis of potential synergies. Mitigation and Adaptation Strategies for Global Change, 12 (5): 855-873.

Salick, J., 2009: Traditional peoples and climate change. Global Environmental Change, 19: 137-139.

Salick, J., F. Zhendong, and A. Byg, 2009: Eastern Himalayan alpine plant ecology, Tibetan ethnobotany, and climate change. Global Environmental Change, 147-155.

Selvaraju, R., A.R. Subbiah, S. Baas, and I. Juergens, 2006: Livelihood adaptation to climate variability and change in drought-prone areas of Bangladesh: Developing institutions and options. Rome, Italy: Food and Agriculture Organization.

Skoufias, E., B. Essama-Nssah, and R. S. Katayama, 2011a: Too little too late: Welfare impacts of rainfall shocks in rural Indonesia. The World Bank Policy Research Working Paper, 5615. Washington D.C., USA: The World Bank.

Skoufias, E., M. Rabassa, and S. Olivieri, 2011b: The poverty impacts of climate change: A review of the evidence. The World Bank Policy Research Working Paper, 5622. Washington D.C., USA: The World Bank.

Srinivasan, A. and A.Q. Al-Amin, 2010: Financing Adaptation in Agriculture and Water Sectors in Asia: An overview. Asian Journal of Environment and Disaster Management, 2 (3): 427-434.

Stucki, V. and M. Smith, 2011: Integrated approaches to natural resources management in practice: The catalyzing role of national adaptation programmes for action. AMBIO: A Journal of the Human Environment, 40 (4): 351-360.

Tanner, T. and T. Mitchell, 2008: Entrenchment of enhancement: Could climate change adaptation help reduce poverty? Working Paper No 106, Manchester, UK: Chronic Poverty Research Centre.

The Government Office for Science, 2011: Foresight: Migration and Global Environmental Change (2011), Final Project Report, London, United Kingdom: The Government Office for Science, 237 pp.

The World Bank, 2007: World development report. The World Bank, Washington D.C. [Accessed 08.05.2011 at http://siteresources.worldbank.org/INTWDR2008/Resources/WDR_00_book.pdf].

The World Bank, 2008: World DataBank. Poverty and inequality database. [Accessed 18 March 2012: http://databank.worldbank.org/ddp/home.do?Step=12&id=4&CNO=1208]

The World Bank, 2010a: Economics of adaptation to climate change: A synthesis report. Washington D.C., USA: The World Bank.

The World Bank, 2010b: World Development Report 2010: Development and Climate Change, World Bank, 424pp.

The World Bank, 2011a: Agriculture, value added (% of GDP). Washington D.C., USA: The World Bank [Accessed 02.06.2011 at http://data.worldbank.org/indicator/NV.AGR.TOTL.ZS].

The World Bank, 2011b: World development indicators 2004. Washington D.C., USA: The World Bank [Accessed 02.06.2011 at http://siteresources.worldbank.org/DATASTATISTICS/Resources/wdi_ebook.pdf].

UNFCCC, 2012: Ecosystem-Based Adaptation. United Nations Framework Convention on Climate Change. Bonn, Germany: United Nations Framework Convention on Climate Change.

UNFCCC, 2014: Risk management approaches to address adverse effects of climate change: Economic diversification. Bonn, Germany: United Nations Framework Convention on Climate Change. [Accessed 20 March 2014 at http://unfccc.int/cooperation_support/response_measures/items/5003.php].

UNFCCC. 2007: Bali Action Plan. Report of the Conference of the Parties on its thirteenth session, held in Bali from 3 to 15 December 2007. Bonn, Germany: United Nations Framework Convention on Climate Change.

United Nations, 2009: Risk and poverty in a changing climate: Invest today for a safer tomorrow. Washington D.C., USA: United Nations, 20pp.

United Nations, 2010: Keeping the promise: a forward-looking review to promote an agreed action agenda to achieve the Millennium Development Goals by 2015. Report of the Secretary-General, Washington D.C., USA: United Nations. [Accessed 17 June 2011 at http://daccess-dds-ny.un.org/doc/UNDOC/GEN/N10/238/02/PDF/N1023802.pdf].

UNU, 2011: University Network for Climate and Ecosystems Adaptation Research. Tokyo, Japan: United Nations University. [Accessed on 17 June 2011 at http://isp.unu.edu].

Uy, N., Y. Takeuchi and R. Shaw, 2011: Local adaptation for livelihood resilience in Albay, Philippines. Environmental Hazards, 10(2): 139-153.

Vargas-Silva, C., S. Jha, and G. Sugiyarto, 2009: Remittances in Asia: Implications for the fight against poverty and the pursuit of economic growth. Manila, Philippines: Asian Development Bank, 28pp.

Warner, K., 2010: Global environmental change and migration: Governance challenges. Global Environmental Change, 20: 402-413.

Wiggins, S. and P. Hazell, 2008: Access to Rural Non-farm Employment and Enterprise Development: Background Paper for the IFAD Rural Poverty Report 2011. London, UK: Overseas Development Institute.

Winters, P., B. Davis, G. Carletto, K. Covarrubias, E.J. Quinones, A. Zezza, C. Azzari, and K. Stamolis, 2009: Assets, activities, and rural income generation: Evidence from a multicountry analysis. World Development, 37: 1435-1452.

Xu, J., R.E.Grumbine, A. Shrestha, M. Eriksson, X. Yang, Y. Wang, and A. Wilkders, 2009: The melting Himalayas: Cascading effects of climate change on water, biodiversity, and livelihoods. Conservation Biology, 23: 520-530.

Zhai, F. and J. Zhuang, 2009: Agricultural impact of climate change: A general equilibrium analysis with special reference to Southeast Asia. ADBI Working Paper Series, Tokyo, Japan: Asian Development Bank Institute.

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