



CLIMATE CHANGE,

YOUNG WOMEN, AND GIRLS:

VULNERABILITY, IMPACTS AND ADAPTATION IN NORTHERN THAILAND

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ACRONYMS

4CA	Child-centred climate change adaptation
BMU	Bundesministerium für Umwelt, Naturschutz Und Reaktorsicherheit (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety)
CCA	Climate change adaptation
DALYs	Disability-adjusted life years
FGD	Focus group discussion
GDP	Gross Domestic Product
IKI	Internationale Klimaschutzinitiative (International Climate Initiative)
IPCC	Intergovernmental Panel on Climate Change
SEI	Stockholm Environment Institute
SRHR	Sexual and reproductive health and rights
STEM	Science, technology, engineering, and mathematics
SUMERNET	Sustainable Mekong Research Network
UN	United Nations
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNICEF	United Nations Children's Fund
WASH	Water, sanitation and hygiene

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INTRODUCTION

Climate change is one of the greatest threats facing our planet and its people. Indisputable scientific evidence shows that global average temperatures are increasing due to greenhouse gases emitted by human activity. Furthermore, climate change is also altering precipitation patterns and intensities around the globe, increasing climate-related disaster frequencies and intensities (i.e. floods, droughts, landslides, wildfires, tropical storms and extreme temperatures), and contributing to national and regional food and water insecurity crises, among other direct and indirect impacts.

Southeast Asia is a regional 'hotspot' for climate change risk owing to high exposure of large populations to climate-related disasters, dependence on seasonal rains for water and food security, and underlying drivers of vulnerability such as high rates of poverty and inequality, unplanned and rapid urbanization, and unsustainable use of natural resources (Garschagen et al., 2016; Thomalla et al., 2017; UNESCAP, 2015). In Thailand, shifts in temperature and precipitation trends have been observed. For instance, between 1955 and 2009, the average annual temperatures increase by 0.95°C, while rainfall patterns fluctuate in different regions of Thailand, according to the Thailand Meteorological Department. Further, Thailand has been severely impacted by recent climate-related disasters, such as the months-long flooding in 2011 and the widespread drought in 2015-16. In Northern Thailand¹, observations include heavier rainfall over shorter durations, increasing incidence of rainy season landslides, more pronounced dry seasons in terms of water availability, and warmer winters (Shrestha et al., 2017).

The agriculture sector is one which is particularly at risk in Thailand; 55% of the nation's total area is under a form of agricultural use, and changes in climatic conditions, particularly reduced rainfall, have the potential to destabilize agricultural productivity and impact upon farmers' incomes and lives. It is estimated that climate change could result in the loss of up to 30% of rural GDP of the lower Mekong region by 2018 (Talberth and Reyntar, 2014).

Vulnerability to climate change, defined by the IPCC as the propensity or predisposition to be adversely affected by climatic risks and other stressors (IPCC, 2012) is socially differentiated. It emerges from the intersection of different inequalities and uneven power structures (Field, 2012; Sen, 1999). Further, vulnerability has been found to be higher (compared with an 'all-of-society' average) among certain groups; groups who experience multiple deprivations that inhibit them from managing daily risks and shocks. These so called 'vulnerable groups' include women, children, the elderly, people with disabilities, ethnic minorities, and indigenous peoples. These groups face deeper climate impacts and significant barriers to coping with, and adapting to, such impacts (Boyd and Juhola, 2009; Eriksen and O'Brien, 2007; O'Brien et al., 2012). For instance, ethnic minorities typically face chronic poverty and lack legal status or citizenship that limits access to land, education, health and other public services.

Research to date has revealed some of the impacts and particular vulnerabilities of children (e.g. Ebi and Paulson, 2010; Sheffield and Landrigan, 2011; Watt and Chamberlain, 2011) but there is

¹ Northern Thailand refers to the region of Thailand consisting of nine provinces: Chiang Mai, Chiang Rai, Lampang, Lamphun, Mae Hong Son, Nan, Phayao, Phrae, and Uttaradit.

a lack of scientific information on the intersectionality of girls' and young women's climate vulnerability, particularly in ethnic minority contexts.

This report seeks to address a major research gap by adopting an intersectionality approach to better understand the different climate risks, vulnerabilities, adaptation and resilience among people of different ages and different genders. In particular, this report aims to shed light on the specific climate change challenges faced by young women and girls in Northern Thailand whose experiences are not only influenced by age and gender, but also by poverty, legal status, ethnicity, language and education.

Producing scientific evidence of the specific and unique challenges faced by girls and young women in these communities is vital for demonstrating to decision-makers, donors and development actors the necessity of gender-sensitive and child-centred adaptation policies, programmes and financing, including meaningful participation of girls and young women throughout all decision-making processes. Policy and action on gender-sensitive and child-centred climate change adaptation (CCA) is urgently needed to support the millions of girls and young women worldwide facing extreme vulnerability and poverty; very few adaptation initiatives targeting girls and young women exist, despite their acute vulnerability.

The next section of the report presents findings from a literature review conducted on existing knowledge on climate change, age and gender. This section is followed by the presentation of the research methodology and the results and analysis of the field research conducted in Chiang Mai and Chiang Rai. Lastly, the report offers conclusions and recommendations for more targeted action on climate change that builds the resilience of young women and girls.

LITERATURE REVIEW

Women and children are often described as “vulnerable groups” in societies at risk from climate change. Women’s and children’s particular climate-related vulnerabilities and impacts have been demonstrated in various sectors, including water resources, food security, human health, livelihoods and poverty, and urban areas (e.g. Field et al., 2014). Girls and young women are at the intersection of gender-specific and age-specific risks, thus explicit assessment of their specific and unique vulnerabilities, impacts and adaptation is required.

2.1 Climate change and children

Children are suffering and will continue to suffer disproportionately from the impacts of climate change (UNICEF, 2015). The 5th Assessment Report of the IPCC concludes with *high confidence* that there will be a substantial negative impact on (i) per capita calorie availability; (ii) childhood undernutrition, particularly stunting; and (iii) undernutrition-related child deaths and disability-adjusted life years (DALYs) lost in developing countries (Field et al., 2014). For instance, climate change could potentially increase the number of undernourished children under the age of 5 by 20 to 25 million (approximately 17 to 22%), by 2050 (Nelson et al., 2009). Without significant adaptation interventions, climate change will likely also increase the proportion of stunted children in countries that are dependent on rain-fed agriculture, as is projected in Kenya (Grace et al., 2012). This is because climate change is expected to increase water insecurity through drought and unpredictability of seasonal rains, and when food availability is reduced, children are generally at greater risk of going hungry and being impacted by associated health outcomes (Cook and Frank, 2008). Further, in small-scale agriculture contexts, including in northern Thailand, women and girls are at greater climate-induced heat stress risk due to the gendered division of labour (Croppenstedt et al., 2013). The time spent by children, particularly girls, on agricultural tasks has also been linked to a rise in school absenteeism and early drop-out.

Children are shown to be at higher risk (compared to adults) of illness, injury and psycho-social trauma associated with climate-related risks, such as floods, droughts and storms, water insecurity, inadequate sanitation and poor hygiene (Perera, 2008; UNICEF, 2015). For instance, figure 1, below, summarises the variety of potential direct and indirect impacts that climate-induced drought/water scarcity can have on girls and boys (UNICEF, 2015). The health impacts of vector-borne diseases associated with water insecurity, including malaria, dengue fever and diarrhoea, are concentrated among children owing to physiological susceptibility (Michon et al., 2007). Children are also likely to be more vulnerable to heat-related illness and respiratory infections linked to extreme temperatures and to air pollution, particularly in urban contexts (Egondi et al., 2012), although evidence of excess heat-related mortality among children is mixed (e.g. Kovats and Hajat, 2008).

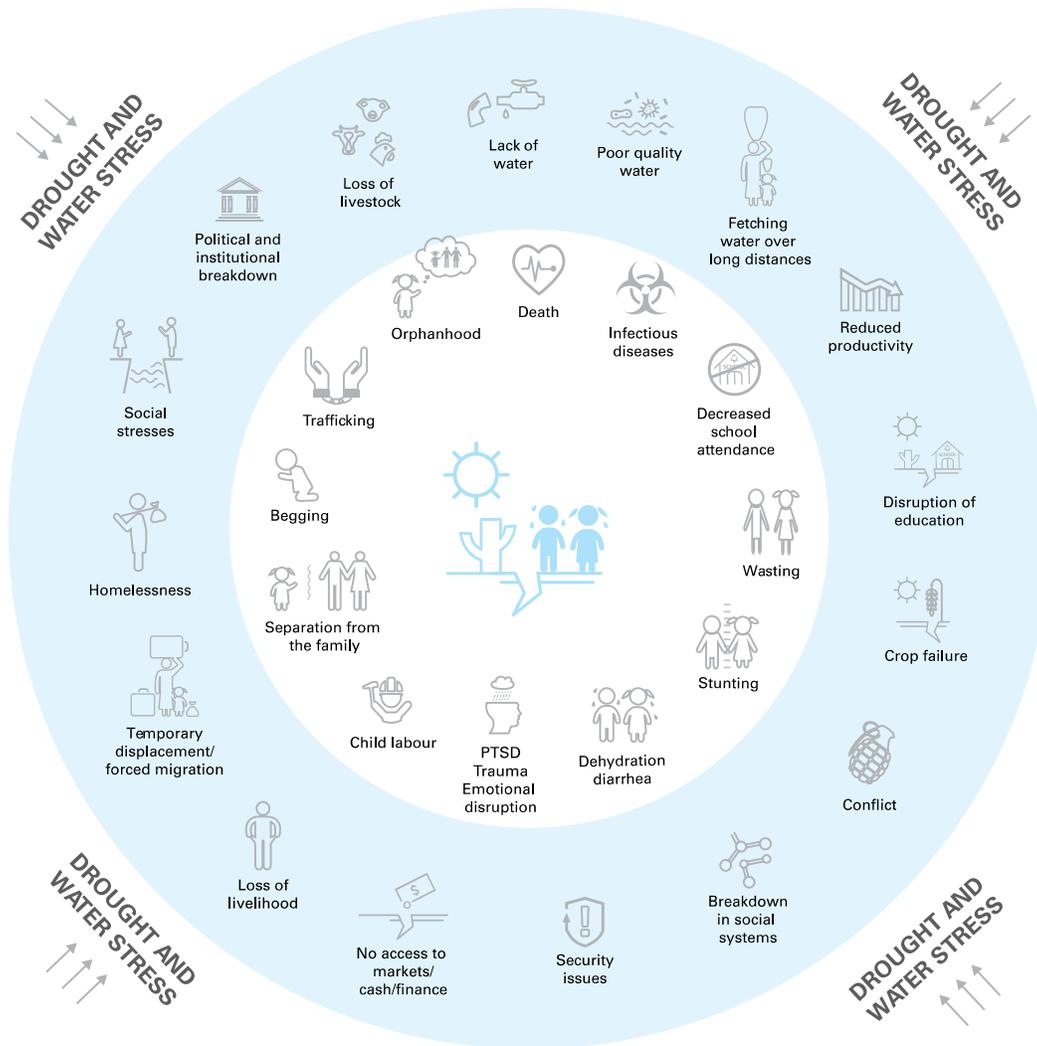


Figure 1. Potential direct (white) and indirect (blue) impacts of climate-induced drought/water scarcity on girls and boys (UNICEF, 2015)

While specific livelihoods alone do not necessarily lead to climate vulnerability, there is robust evidence that the socially and economically disadvantaged and the marginalized are disproportionately affected by the impacts of climate change (e.g. Cardona et al., 2012). Children are known to suffer the consequences of household/family poverty traps, defined by Carter et al. (2007, p. 837) as the “critical minimum asset threshold, below which families are unable to successfully educate their children, build up their productive assets, and move ahead economically over time”. Poverty traps reduce access to education and heighten susceptibility of girls and women to unsafe economic migration and sexual exploitation.

In urban areas, where there is often a high concentration of informal settlements, or slums, children are at acute risk of suffering from malnutrition, inadequate water supplies exacerbated by urban heat stress, and water-borne diseases heightened by excessive rains and localized flooding (Bartlett, 2008). A lack of adequate housing deprives children of a comfortable, healthy, and secure living environment that also acts to protect from injury, damage, livelihood disruption and climate-induced displacement (Bartlett, 2008; Haines et al., 2013). Poor access to electricity,

infrastructure and transport, low incomes, limited assets, and dangerous locations further increase risks for the urban poor, and disrupt children's lives and education (Moser and Satterthwaite, 2008).

Children's adaptation to climate change requires broader adaptation strategies and decision-making actors to actively consider the needs and perspectives of girls and boys, and their long-term futures should be invested in. Children must have an active voice and meaningful participation in institutions and processes that shape climate action. It must be recognized that climate change exacerbates inequities, and the underlying factors driving these inequities must be tackled in tandem with traditional sectoral adaptation measures.

2.2 Climate change and gender

Agricultural livelihoods remain an important source of income in rural areas in many developing countries, including in Northern Thailand. In the rural communities of Chiang Mai and Chiang Rai, men, women, and often children, play a role in agricultural production. Water is a critical natural resource for agricultural livelihoods, however water insecurity is growing in Northern Thailand as climate change impacts increase. While both men and women need water for their livelihoods, as well as for their health and the health of their families, access to, and control over, water resources differs greatly among men and women (Parker et al., 2016). Differential access between men and women is rooted in prevailing power structures, societal norms, and the gendered division of labour (Bakker and Morinville, 2013; Knapman and Sutz, 2015). In general, men hold most water-related decision-making power and rights to water access (UN, 2013). The current body of literature shows that women in rural areas, particularly those who are poor and from an ethnic minority, may face disproportionate water insecurity compared to rural men and people in urban areas due to overlapping sources of vulnerability and marginalization (Andajani-Sutjahjo et al., 2015; Asthana, 2010; Pham et al., 2016; Tinoco et al., 2014).

In addition to the livelihood-related challenges of water insecurity which may lead to loss of income, women are often seen as being primarily responsible for unpaid domestic labour. This includes cleaning, cooking, caring for children and taking care of home gardens for household food consumption. Water scarcity can increase women's workloads as they are often responsible for household water procurement, and therefore need to spend more time collecting water to complete household tasks (Huynh and Resurreccion, 2014). In Northern Thailand, young women and children, often girls, often contribute to domestic work to alleviate the heavy workload of their mothers (Webbink et al., 2012). They are also often required to participate in agricultural labour to contribute to the family's income. As water insecurity increases due to climate change, women and children, particularly girls, will continue to face the double burden of being primary household caretakers and agricultural laborers; both of which require significant amounts of water (Andajani-Sutjahjo et al., 2015).

While the body of research on gender and climate change is fairly well-established, there has been a long-standing tendency to narrowly focus on female vulnerability, often portraying women and girls as homogenous groups and obscuring other forms of inequality (Djoudi and Brockhaus, 2011; Ravera et al., 2016). This narrow interpretation of their experiences presents them as a passive group without agency and overlooks other structural factors shaping their experiences, as well as the positive roles that they can play in adaptation (Arora-Jonsson, 2011; Dankelman, 2010; Mitchell et al., 2007). More research is needed on how gender influences adaptation and adaptive capacity, and how existing adaptation strategies may reduce, maintain, or even exacerbate gender inequality in different contexts over time (Onta and Resurreccion, 2011).

Existing studies demonstrate that the adaptation strategies adopted by people are influenced by a variety of social, economic and cultural dynamics, and negotiated through gendered perceptions of the social-ecological context and varying levels of decision-making power (Ravera et al., 2016). The varied experiences of men and women in the context of climate change, and their differential natural resource needs, are likely to influence climate change perceptions which serve as the basis for future decision-making on adaptation. In many contexts, men tend to hold more decision-making power than women, and thus may be more likely to make adaptation choices on behalf of their households (Lehman, 2016). These adaptation choices may not sufficiently address the needs of women and girls who may be particularly disadvantaged as they face unequal access to, and control over natural resources, and have disproportionate responsibilities for household labour—both of which are negatively affected by climate change.

In practice, adaptation strategies can bring benefits to some groups, while disenfranchising others. Livelihood diversification, including crop diversification, is a commonly cited form of adaptation (Djoudi and Brockhaus, 2011; Pelling, 2011). In farming communities, planting more drought-resistant crops is often seen as a positive step towards adaptation (Selvaraju et al., 2006). However, empirical evidence suggests that such changes in agricultural practice may simply reinforce gendered divisions of labour as women are often responsible for tending to crops, thus limiting the potential for gender-transformative adaptation (Onta and Resurreccion, 2011).

Furthermore, the ability to harness adaptation options varies across society, including among men and women. For example, the potential of migration as an effective adaptation strategy is increasingly explored in the literature (Black et al., 2011; Wilkinson et al., 2016). Yet, opportunities for migration and other forms of adaptation are mediated by gender norms and expectations, potentially affecting the uptake of these strategies by people on the basis of gender and other social factors. In Thailand, evidence suggests that migration from climate change impacts, namely floods and droughts, was higher among men than women (Curran and Meijer-Irons, 2014). The lower rates of female migration were attributed to stronger household and land ties among women, therefore rendering migration a less viable adaptation strategy for them. Male migration may place a greater burden on women who do not migrate as they must continue to fulfil their previous roles while now making up for lost male labour. While this increases the time and physical labour commitments of women, and often girls who support their mothers, the shifting roles and responsibilities of women due to male migration may also serve to challenge long-standing and largely male-dominated power structures as the number of female-headed households rises (Djoudi and Brockhaus, 2011). Therefore, the potential that male out-migration has for being a catalyst for transforming gender relations in the long-term should be explored, while also being conscious of the burden it can place on women and girls.

In summary, there is growing evidence that climate change is highly likely to compound both children's and women's pre-existing vulnerabilities, such as poverty, low access to education and knowledge, food and nutritional insecurity and water and natural resource access. Evidence suggests that children may also face protection issues including child, early and forced marriage, and that women may encounter challenges in relation to livelihoods, household labour and natural resources management. While the respective bodies of literature on children and gender in the context of climate change are growing, they contain critical gaps. The literature on children and climate change appears largely gender-blind; failing to explore deeply the potential differences between girls' and boys' experiences with climate change. Similarly, the body of literature on women and climate change is largely age-blind, overlooking the importance of age in shaping the different challenges and opportunities faced by women and men of different ages in responding to climate change.

In recent years, some climate change researchers have shifted to a more nuanced view in which gender and age intersect with each other, and with other identities and forms of social difference, including ethnicity, social class, legal status, and caste to determine climate change vulnerability (Huynh and Resurreccion, 2014; Ray-Bennett, 2009; Tschakert, 2012). By analysing the complex interplay of multiple social, cultural, and economic factors with gender and age, prevailing power imbalances can be illuminated which helps to explain how people experience climate change in different ways (Carr, 2008). Intersectionality also sheds light on the differential access people have to knowledge, social and financial capital, and networks which underpins their (in)ability to pursue adaptation strategies (Ravera et al., 2016).

STUDY CONTEXT

In the mountainous regions of Northern Thailand there are many rural and relatively remote villages which are largely inhabited by people of ethnic and linguistic minorities living alongside the Thai-Myanmar border, including Akha, Lahu, Lisu, Thai Yai, Yao, and Lawa. Many of these people are stateless, without a Thai or Myanmar nationality. People in these villages tend to be poor with low levels of education, relying heavily on subsistence agriculture to meet their livelihood and food consumption needs. Mostly settled in upland mountain agro-ecosystems, these communities are water and natural resource-poor, making them highly vulnerable to climate change. Rural poverty is likely to be deepened as climate change impacts farming production and food prices. Further, indigenous and ethnic minority communities are known to be particularly at risk, due to compounding factors such as lack of government support, lack of infrastructure, insecure land tenure and lack of citizenship, and access to basic services such as health and education (Field et al., 2014).

The intersection of these various social, economic, cultural, geographical, and linguistic characteristics with gender and age can influence access to health and social services, education, employment, and natural resources. Climate change impacts can exacerbate pre-existing inequalities created by these intersecting characteristics, further limiting access to these critical services and resources for women, men, girls and boys. It also impacts the adaptation strategies that these communities prioritize and adopt. It has been shown that Northern Thailand farmers' adaptation practices are influenced by socio-economic factors, adaptive capacity, and traditional practices (Shrestha et al., 2017).

METHODOLOGY

This research aims to illustrate the climate change vulnerability, impacts and adaptation of girls and young women in ethnic and linguistic minority communities in Chiang Rai and Chiang Mai provinces in Northern Thailand. Producing scientific evidence of the specific and unique challenges faced by girls and young women is vital for demonstrating to decision-makers, donors and development actors the necessity of gender-sensitive and child-centred adaptation policies, programmes and financing, including meaningful participation of girls and young women throughout all decision-making processes. As highlighted in the literature review, there is a clear need for more scientific evidence in this regard. Thus, our research questions are as follows:

1. What are the climate change risks faced by girls and young women in ethnic and linguistic minority communities in Northern Thailand?
2. What are the underlying vulnerabilities and impacts of climate change for girls and young women in ethnic and linguistic minority communities in Northern Thailand?
3. What adaptation measures are building the resilience of girls and young women in ethnic and linguistic minority communities in Northern Thailand?

Building off of the literature review findings and gaps, and informed by Plan International's climate change framework, we analyse girls' and young women's climate change risks, vulnerabilities, impacts and adaptation. Across the climate change framework components, we explore dimensions of gender roles and power relations, water security, livelihoods, food and nutritional security, health, education, and migration. Qualitative methods are used to gather empirical data relating to each framework component and dimension from i) key informant interviews with young women aged 15-30, and school teachers and principals, and ii) focus group discussions (FGDs) with girl and boy school children aged 10-15, young women aged 15-30, and village CCA committees.

Data were collected from six schools and six villages across nine different locations in the districts of Mae Fah Luang (Chiang Rai province), Fang and Mae Ai (Chiang Mai province). A total of 26 interviews and 17 FGDs were conducted, involving a total of 157 participants, as summarized in Table 1 (see Annex for full details). The selection of research participants was determined based upon age and gender, a voluntary willingness to participate, and familiarity with Plan International programming and staff. We obtained research ethics approval from Plan International Headquarters prior to the commencement of data collection. Ethical data collection procedures included obtaining informed, signed consent from all participants, ensuring confidentiality and anonymity of participation, and informing participants that they could withdraw from the process at any point. For data collection from children, all researchers and translators signed and acted in strict accordance with Plan's Child Protection Policy and SEI's research code of conduct. For instance, we sought informed, signed consent from both teachers and children, and steps were taken to ensure no stress was caused to any children. All gathered data were stored in password-protected files only accessible to members of the research team.

Table 1. Summary of interviews and FGDs conducted, and number of participants

	No. of interviews and FGDs	No. of participants
Interview with young women	14	14
Interview with school teacher	12	12
FGD with school children	8	61 [35G, 26B]
FGD with young women	3	13
FGD with CCA committee	6	57 [21W, 36M]
<i>Total</i>	43	157

Interview and FGD questions were written in clear, accessible and gender-, age- and culturally-sensitive language, and different data collection tools were used for each informant group. Questions were written and asked in English, with qualified translators asking translating and asking the questions in either Thai or the local language, depending on the location contexts and which language the participants were most comfortable communicating in, where possible. The interviewers and translators were trained on the subject matter and research methods to ensure that they had a strong understanding of the tools and the skills capacity needed for conducting interviews and supporting the facilitation of FGDs with both children and adults.

The evidence presented in this research report is intended to firstly strengthen the evidence-base and secondly inform policies and programmes on climate change; specifically aiming to highlight the gender- and age-differentiated experiences of climate change risk, vulnerability and adaptation. This report may be useful for researchers, local governments, donors, adaptation and development practitioners, and other civil society actors engaged in adaptation planning and implementation.

RESULTS AND ANALYSIS

In this section we present and analyse our empirical results². First we describe gender roles and power relations, second climate change risks, third climate change vulnerabilities and impacts across six sectors – water security, livelihoods, food and nutritional security, health, education, and migration, and fourth adaptation.

5.1 Gender roles and power relations

“Both men and women work on the farms, but women do extra jobs at home and have to work more”

(Man, village CCA committee member)

Gender roles in most communities are quite distinct, although some perceive that roles have become less separate than they were previously^{3,19,37}. In the past, women’s sole role was to raise their children. Now, women also generate income, as well as remaining as the primary caregivers and ones responsible for the household^{9,38,39}, which adds to the responsibilities and burdens of women.

5.1.1 Gender roles at work

All communities and households are predominantly farmers, including those who own or work on farms within their communities (e.g. tea, coffee and corn farms), day-labourers of farm plantations (e.g. tangerine farms), and those who work on Royal Projects (e.g. strawberry farms). On the farm, typically both men and women work, but women have primary or sole responsibility for some tasks. In villages in Chiang Mai, both men and women have responsibilities, e.g. planting, ploughing, harvesting, selling the product at market or to factories (e.g. corn mills)^{25,32,37}. In some villages in Chiang Rai, women are primarily responsible for harvesting tea leaves and coffee beans^{7,11,12,17}. Some roles are seasonal, such as harvesting coffee beans (Nov-Dec)⁸. Daily maintenance of the farmland (e.g. watering, weeding, spreading fertilizer and pesticides) tends to be the responsibility of women, and can take anywhere from 30 minutes to all day, depending on the crop, size of plot and time of year^{7,32,36}. Women are responsible for the sale of product to nearby factories, while men are more likely to transport the product to factories located further away from the village^{7,32,33,35}. Seeking additional day-labour work when necessary is common³³.

Young women are engaging in farming in all villages, performing a range of roles as described above^{26,33,35}. Many have married in their mid- to late-teens and must balance childcare and work responsibilities^{36,38,39}. Some women (e.g. divorced or widowed) have no support for childcare so must bring their young children to the farm and carry them on their back while they work^{11,26}. Others get childcare support from friends and relatives, but may not see their children as regularly if their parents live far away³⁹. Few can afford to pay for childcare services³⁸.

In almost all villages, it is commonplace for children to help their parents and other relatives on the farm. In some cases, both boys and girls help, for instance with tea leaf harvesting and fruit

² Throughout this section we use superscript numbers to indicate which interviews and FGDs the findings are derived from. The report Annex lists each of the 43 interviews and FGDs conducted, and the corresponding number code.

picking^{1,3,7,14,21,23,25,41,43}. In other cases, girls help more than boys during harvest of tea leaves, coffee beans, corn and vegetables¹⁴. Some girls also help maintain the plots (e.g. watering) and go with parents to sell produce at markets^{14,24}. Boys and girls typically help at the weekend, during school holidays or of a morning before school starts^{7,14,21,23,25,29,41,43}.

By and large, both women's and men's roles at work centre around agriculture and the variety of tasks associated with farming. In villages in Chiang Mai there appears to be a fairly even investment of time and division of labour between men and women for farming duties, from planting to harvesting to selling. In villages in Chiang Rai, women have primary responsibility when it comes to harvesting tea leaves, for example, which is a fairly regular duty. The daily maintenance of farmland is also primarily the work of women, as is the sale of products at market or to suppliers, although men are more likely to support in purely manual labour duties (e.g. loading and unloading produce). In Akha ethnic communities, the active roles of women in farming is a relatively new phenomenon as traditionally a woman's sole role is child- and family-care and household duties. The trend of more women in farming has been termed the 'feminisation of agriculture' and has been seen in other parts of Asia.

Under a changing climate, this leaves women more likely to be exposed to climate extremes, i.e. heat and rain, when farming. Further, as climate change continues to negatively affect crop yields and quality, women will face increasing pressure and burden to maintain farms and implement new practices in attempt to save failing, damaged or dying crops. Under increasingly challenging and demanding conditions, women and men are turning to their children for support with farming and also other income-generating activities. Children need to fit these additional duties around their education, and in some extreme cases work on the farm, particularly during harvests, takes the place of attending school for weeks or months at a time.

5.1.2 Gender roles and power relations at home and in the community

Women have primary or sole responsibility for care-giving and household-related duties. Young women with families typically have sole responsibility for all main tasks: cooking, cleaning, washing clothes, bathing children, taking children to school, and caring for elderly relatives in the household^{7,8,9,11,12,13,19,26,28,33,34,35,37,38,40}. Some care for the children of others¹⁰, and for younger siblings¹⁹. Some receive support with these tasks from their husbands^{26,28,34,36,39}, while others' husbands have separate responsibilities such as collecting firewood and taking care of animals and livestock^{26,36}. Some young women receive no support with household tasks at all because their husbands live and work in Bangkok and return home infrequently^{8,9,10,19}.

Young women and girls that are unmarried and still in education support their parents, particularly mothers, at home, typically after school and at the weekends/during holidays^{3,19,23,24,29,41,43}. Children help with sourcing food, collecting firewood, taking care of home gardens, and making goods to sell at market^{3,12,14,31}. It is typical for girls to help around the house more than boys, for example with taking care of siblings, cleaning, washing dishes, cooking^{1,4,7,14,15,20,21,23,24,30,41}. Though, boys still do help with household tasks^{12,14,20,21,24,31}. Primarily girls tend to take over the household roles when their parents are absent, for instance while they are farming¹⁵.

Young women engaged in farming are also invariably handling work roles together with (rather than instead of) their more traditional roles of childcare and household maintenance. For instance, some women bring babies or young children to work and carrying them on their backs in lieu of childcare support, which increases the physical burden of manual work for women. Women continue to also be the ones primarily responsible for household-related duties in homes that might inhabited by extended family members, young children, parents-in-law or elderly people,

further increasing the demands on women in terms of cooking, laundry, cleaning and general upkeep of the home. As a result, mothers are increasingly turning to their daughters for support with duties at home. This may be partly driven by the expectation that girls will take over the household roles when their parents are absent, or when they marry and start their own families.

5.1.3 Gendered power relations

Power dynamics can shape both community cohesion and conflict in times of climate change and risk. Village heads and community CCA committees are overwhelmingly male^{7,12,17,25,32,37}. Monthly meetings are typically held in which one representative per household is expected to attend¹⁹. Although there tends to be greater female representation at these meetings^{11,12}, women generally speak out less than men even if there are more of them in attendance¹⁹. This points to prevailing gender norms within the communities in which men generally yield greater decision-making power within the household and the community, and women's views are ignored or under-valued by men^{19,34}. While most young women perceive either their fathers, grandfathers, or husbands, if married, to hold the greatest overall decision-making power within their household^{9,34,35,38,39}, many young women feel that they have a better understanding of their family's financial situation^{28,34,39}.

Despite the growing role of women in work, namely farming, men continue to yield greater decision-making power than women at the community level. This is also true at the household level, but women often have responsibility for allocating financial resources. Everyday practices produce and reinforce social differences, gender norms, roles and power relations that restrict women's empowerment in important community-level decision-making processes. This is particularly true for young women, whose respect for men in seniority under cultural norms typically silences them. Despite being the ones primarily responsible for sourcing water, women, particularly young women, had low levels of awareness on how decisions were made regarding natural resource access. With little involvement in these processes, young women are likely to continue shoulder the burden of inequitable resource distribution which will continue to increase the amount of time needed to secure water during times of water scarcity. If women are expected to be on the frontline of climate change then they deserve a seat and voice at the table that decides how best to cope and adapt, for example in terms of resource allocation and use during times of water scarcity.

5.2 Climate change risks

“I've seen floods, storms, landslides but droughts seem to happen every year in the summer. It's really hot but mother says we have to try to use less water at home”

(School girl, grade 5)

The first section of the results briefly describes the types of climate change risks present in study locations, organized by i) climate-related extremes, and ii) climate variability. Then, the next section of the results describes the vulnerability and impacts of how these identified climate risks (extremes and variability) are experienced, in relation to each of the following sectors: gender roles and power relations, access to water, livelihoods, food and nutritional security, health, education, and migration.

5.2.1 Climate-related extremes

The six climate-related risks identified are drought/water scarcity, storm (including hailstorm), flood, landslide, fire, and extreme temperature. Tables 2 and 3 below show which risks were

identified by which informant group in each village (informants: village CCA committees, young women) and school (informants: teachers, school students). In case of interviews (i.e. young women and teachers), a risk is considered as being present when at least half of the participants in a location have identified that risk. In the case of FGDs (i.e. school students, village CCA committees) a risk is considered as being present when at least half of the participants have identified it and/or agree that it has been experienced.

The tables show that drought/water scarcity is the most commonly identified risk by all informant type, and is in fact present in all villages and schools, as is storm risk. Floods and landslides are regularly identified, although not in all locations. Forest fires and extreme temperature are the least common risks identified by all informant types.

5.2.2 Climate variability

Climate change also affects the variability and predictability of climate and weather patterns. In almost all villages, an increase in the unpredictability of the seasons, weather, temperature and rainfall is identified by informants^{3,7,9,11,12,17,19,32,37}. Seasonal changes, related to season duration, timing and intensity, are also being experienced in most study locations. Many feel they are experiencing hotter and drier dry seasons^{7,8,12,22,24,25,32,37,42}, longer dry seasons^{7,12,17,24,25,37}, heavier and more intense rain events^{3,7,12,25}, and longer rainy seasons^{13,17,19,24}.

Table 2. Climate-related disaster risks in each village, as identified by CCA committees and young women

Climate risk identified	Village 1		Village 2		Village 3		Village 4		Village 5		Village 6	
	CCA Committee	Young women										
Drought/water scarcity	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Storm (including hailstorms)	✓	✓		✓	✓	✓	✓			✓	✓	✓
Flood								✓	✓	✓	✓	✓
Landslide	✓	✓				✓	✓		✓	✓	✓	
Forest fire								✓				
Extreme temperature	✓	✓	✓		✓	✓	✓			✓	✓	✓

Table 3. Climate-related disaster risks in each school, as identified by teachers and students

Climate risk identified	School 1		School 2		School 3		School 4		School 5		School 6	
	Teachers	Students										
Drought/water scarcity	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓
Storm (including hailstorms)	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Flood			✓	✓	✓		✓	✓		✓		
Landslide	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
Forest fire	✓	✓							✓	✓		
Extreme temperature			✓		✓	✓		✓		✓		

In case of interviews (i.e. young women and teachers), a risk is considered as being present when at least half of the participants in a location have identified that risk. In the case of FGDs (i.e. school students, village CCA committees) a risk is considered as being present when at least half of the participants have identified it and/or agree that it has been experienced.

5.3 Vulnerability and impacts

In this section we present and analyse results concerning the climate change vulnerability and impacts of young women and girls in relation to six key sectors – water security, livelihoods, food and nutritional security, health, education, and migration. For each sector, we present results at community, household and individual scales, and then discuss the specific implications for young women's and girls' risk and vulnerability.

5.3.1 Water security

“Every day I walk to the village head's house to fill up a 20 litres tank with water and then carry it home on my back. I do this alone, three times a day”

(Young woman)

Climate change has had serious consequences on water availability and access in Northern Thailand. In several communities, residents reported seasonal water shortages, or that water supply was lower than in past years^{12,25,32}, and that these changes have been occurring over the past five years^{12,25}. The decreased supply of water may also be linked to increased population size within some villages due to higher birth rates and increased in-migration in recent years¹². Water is typically stored in public tanks and each village has multiple tanks that are intended to serve several households^{25,29,37,33,35}. While some villages and schools experienced low water levels in their tanks^{2,17,23}, others had to deal with tanks that were completely dry, sometimes for periods of up to 20 days¹⁷. This also affected schools who experienced days with zero water supply during droughts⁴². However, the water supply is not only affected during periods of drought. In one village, eight of the village's 11 water tanks are empty year-round, and this is exacerbated during periods of drought when the remaining three tanks also become empty¹².

At the village level, water scarcity has resulted in a lack of sufficient water for drinking, bathing and sanitation, practicing agricultural livelihoods, and growing vegetables for consumption^{7,12,16,19,25,32}. To cope with water shortages, particularly during droughts, villagers take a number of actions including: pumping water from nearby rivers^{30,32}, taking containers to the closest water source and transporting them back home^{25,32}, harvesting rainwater³, pumping groundwater from community wells^{35,37}, using shared 'communal' village water taps²⁶, or requesting water tank deliveries from their municipalities³². However, villagers have raised concerns on the quality and safety of water from these sources⁷, for instance they are worried about the safety of drinking the rust-coloured water from wells³⁷. In all locations, alternative water sources were also depleted, and many had to resort to purchasing water from privatized water delivery companies^{7,12,17,25,32,37}. The prices charged by these companies increase annually, and are particularly high during periods of drought, representing a huge financial burden for villagers who often already struggle to make an income.

Young women in nearly all of the target villages highlighted challenges in accessing water^{9,11,19,36,38}. The lack of access to water creates a serious burden for women in particular as they are largely responsible for water collection for their households¹³. During periods of water scarcity, young women are required to travel further to find alternative water sources. Since water is increasingly hard to find due to climate change, and the closest available water source may now be located farther away, young women need to spend more time securing and transporting water, often traveling by foot^{13,26,32,40}. Some young women collect water several times a day during droughts which can last up to three months, often carrying water containers of up to 20 litres on their backs^{9,36}. Furthermore, the water from alternative water sources, such as rivers, is perceived

as not being clean or safe^{28,40}; but young women feel that they “have no choice” but to use this water due to a lack of other options¹³. The perceived poor quality of water has driven some young women to purchase purified drinking water from privatized sources^{8,10,11}, although some young women from poorer families cannot afford this.

The lack of water has had direct impacts on the workloads of young women. Despite efforts to secure water, some young women feel that they do not have enough for their household needs³⁶. In some cases, young women have difficulties accessing water for periods of several weeks¹⁹. While this raises serious concerns for the entire household, it is particularly challenging for women who are primarily responsible for household labour which involves tasks that are highly water-dependent, such as cooking, cleaning, washing clothes, bathing children and growing vegetables in home gardens¹⁹. During times of water scarcity, young women are unable to wash their dishes and clothes or bathe themselves or their children at home. They must increasingly travel to rivers and streams^{12,13,36,39,40}, or neighbour’s homes that have water access to do this^{19,35}. In other cases, young women cope by reducing their water consumption within the household^{13,19,26}, for example by more infrequently washing clothes or watering their home gardens^{13,19}.

Water scarcity also has direct impacts on children, both at home and at school. Some children do not have enough drinking water at home during times of scarcity^{29,31}. The lack of water supply at home also means that children must go to bathe themselves in rivers, even if the water there is seen as being unclean. Even when girls and boys were aware that the water was dirty, and that it caused skin rashes, it did not prevent them from going back^{14,24,31,43}. Children, usually girls, also assist their mothers in washing clothes for their families at rivers, increasing the amount of time they are in contact with the water^{14,24}. Furthermore, it is usually girl children who are responsible for supporting their mothers in collecting water for their household, namely carrying containers to water sources to fill them up^{22,24,31,43}. This water is not always clean or safe⁴³. In addition to the potential health concerns, these water insecurity challenges also increase the time needed for children to complete household work, of which girls tend to have a much larger share of.

At schools, there are severe water shortages during droughts²² and children are encouraged by teachers to reduce water usage^{3,22}, for example, when using the toilet²². While this is a challenge for both boys and girls, girls face particular challenges during menstruation when they need access to water for hygiene and sanitation purposes. During periods of extreme heat, children need to drink more water¹⁴, however as this usually corresponds with periods of drought, there is not always sufficient drinking water available for children at schools²¹. When there is insufficient drinking water at school, students are expected to bring it from home²². However, households face similar challenges in securing water. The increased pressure to secure water for consumption at school may provide additional stress on those responsible for water collection, often young women and girls, and increase the amount of time needed to source sufficient quantities of water.

There are issues of equity regarding access and distribution of water in some villages, which are likely influenced by underlying power dynamics. In one village, water use for irrigation is rationed during times of scarcity, which can cause tensions and conflicts between water users³⁷. In another village that has been experiencing severe water shortages for the past two years, the village head has consistent water supply in his home, while other households in the village have very little to no water supply at their homes⁹. Similarly, some households in villages receive piped access to water tank, while other households do not and must physically collect water from other tanks or water sources^{9,11}. Despite clearly recognizing the inequitable distribution of water and access to it, many young women feel scared to raise these issues publicly and therefore do not request transparency from village officials regarding decision-making on water distribution^{9,11}.

5.3.1.1 Implications for young women and girls

Water insecurity during times of scarcity has a range of impacts on young women and girls, including in relation to household responsibilities, health and education. The burden of water insecurity falls predominantly on young women and girls, who are largely responsible for sourcing water for household consumption. In times of water scarcity at schools, young women and girls also need to source additional water to compensate for the lack of water available to themselves or to their children at school. As climate change impacts worsen, young women and girls will likely need to travel even further to find sufficient quantities of water. This represents both a significant time and physical burden for women and girls, and the lack of water raises clear sexual and reproductive health concerns, particularly during menstruation and pregnancy. Furthermore, young women and girls may be reprimanded by others in their household if they are not able to fulfil their responsibility of securing enough water to meet all of their family's needs. As the amount of time that young women and girls need to complete household duties, which are often highly-water dependent, increases during times of water scarcity, they have less time available for educational or leisure activities. For example, it takes away from time that young women and girls would otherwise spend studying, with friends or playing outside, and thus may have implications for their education and well-being.

Widespread concerns over water quality have driven some young women to purchase purified drinking water from privatized sources. However, young women who are poorer, or that have limited control over household financial resources, cannot access this water, and may be more adversely affected by poor water quality and face disproportionate health consequences. This highlights the differential impacts among young women of different socioeconomic statuses, which also has implications for their children, especially girls, who are also likely to face more health impacts from reliance on unsafe drinking water. Inequitable distribution of water within villages based on social and economic positioning may also have a greater impact on poorer, female-headed households as many young women are fearful of demanding accountability from village leaders on transparent water allocation decisions.

The contamination of rivers and streams used for washing clothes and bathing during droughts poses another serious health risk, particularly for young women and girls who spend large amounts of time there. Despite awareness on the relationship between contact with contaminated water sources and an increase in skin rashes and illness in their children, the continued use of these water sources by young mothers demonstrates the unavailability of other, safer options. The low levels of awareness among young women on the causes of contamination in water sources, which are likely affected by heavy pesticide use in upstream farms, highlights a major knowledge gap and may hinder their ability to demand accountability from upstream farm owners.

5.3.2 Livelihoods

“During the dry season, I must now find work with a daily wage, such as selling garlic, so that I have enough income to buy food for my family”

(Young woman farmer)

The households within the nine study locations largely rely on agricultural labour for their livelihoods; some households own farms, some are day labourers and some work on the Royal Project farms. In response to declining agricultural incomes, some young men have sought work as construction labourers^{7,8,12,17,20,31,32}, while some young women have found employment as day-labourers on other people's farms^{33,35}, or earn additional income by making and selling souvenirs to tourists²⁶. However, non-agricultural livelihood opportunities are often male-dominated in rural

areas, and therefore young women often must migrate to cities to find alternative employment, for example, in restaurants, in factories or as maids^{7,11,12}. Young women who work as farmers or as day labourers are still largely responsible for all household work and raising children.

A variety of crops are grown for income, the main ones being tea^{7,12,17,19}, coffee^{7,12,17}, corn^{25,32,33,35,37}, vegetables^{25,31,32,37}, fruits^{25,31,32,37,43}, herbs and chili^{32,37,39}. In Chiang Rai, villagers used to grow more corn and rice, but in the past five years or so, many have shifted to grow more tea and coffee due to higher and more stable pricing. Also, tea is more regularly harvested than corn, with tea being harvested monthly, while corn is only harvested annually^{7,12,17}. In some cases, coffee production is expanding, even replacing tea^{7,8,10}. In Chiang Mai, many villagers grow strawberries as part of the Royal Projects^{25,26,29,31}, and corn to sell at corn mills³², and harvest tangerines and other fruits on large plantations^{25,32,37}. Those that grow corn suffer from price fluctuations linked to seasonal changes³⁴.

Adults and children alike perceive climate change as making farmers' lives more difficult and as something that negatively impacts incomes^{5,9,11,19,26,32,38}. In over half of the locations, storms and heavy rain have waterlogged and damaged crops and/or killed livestock^{6,7,10,17,19,25,32,33,35,37,40}. Similarly, landslides have destroyed crops and blocked access to roads in six out of the nine locations studied^{6,7,8,10,16,32,35,37}.

A perceived intensification and lengthening of the dry season has severely impacted farmers. For example, tea farmers must contend with reduced crop quality and quantity, and the younger plants often die due to heat stress^{7,12,17}. However, it is possible to get a higher price for tea in the dry season because it is generally less abundant^{12,17}, but the quality is often low⁷. Availability of water for irrigation also impacts corn and rice farmers' livelihoods because crops cannot grow or die off^{25,26,32,33,35,37,38,40}. Daily wage labourers find less work during droughts^{22,42}, and this results in significantly reduced income for some^{26,32}. Another challenge faced by farmers is the rising price of agricultural inputs, particularly fertilizer and pesticides³⁷, causing some to accumulate debt with the sellers³⁴. Some feel pesticide use is unavoidable in the face of climate change²² but also that it helps to improve the visual appearance of crops, making them easier to sell. Partly in response to challenges in agricultural livelihoods, many young men, and some young women, are seeking alternative and supplementary sources of income in the area, such as in construction or service industries, and in some cases, even economic migration to Bangkok or other urban centres.

Another consequence of climate change impacts is the increased involvement of children in agricultural work. Girls and boys support their parents and other relatives to harvest crops, spread fertilizer, maintain farms and sell products at market^{4,25,31,41,43}. Sometimes this occurs before school, on the weekends and during school holidays, and sometimes children must miss school to work on the farm, particularly to assist with harvesting^{3,4,22,25,29,31,41,42,43}. In one location, girls also help their mothers make and sell souvenirs to tourists, in addition to farm labour²⁹.

5.3.2.1 Implications for young women and girls

Both adults, youth and children recognize the negative impacts that climate change has had on farming livelihoods. Reduced income from farming livelihoods due to climate change has required households to take a range of different decisions to cope with the financial losses. The decision by some households to have young women take on a larger share of agricultural labour places an additional burden on women who must already spend large portions of their time on unpaid domestic labour. There is a perception among many young women that their household responsibilities did not constitute 'labour', even if they require several hours of work each day. This may be related to prevailing cultural understandings in which labour is perceived only as

those activities that generate income and unpaid work may therefore be less valued. The time and physical abilities needed for completing it may also be underestimated, particularly by men.

The growing pressure to work more on farms is particularly challenging for young mothers that have infants and young children at home requiring care. Increased work on farms means that they must seek alternative childcare arrangements, often relying on relatives or neighbours. In some cases, young mothers are required to bring their children with them while they work. One mother in Chiang Mai province shared how she regularly brought her infant child with her to the farm, carrying the infant on her back for several hours while she picked tea leaves. Fathers who worked on farms did not mention the need to tend to their children while practicing their livelihoods. This illustrates a clear difference in parental responsibilities between men and women, in which women are expected to take the primary role despite working similar hours as their husbands on paid labour, and in addition to having near sole responsibility for unpaid domestic labour.

In addition to farm labour, there is increasing pressure on young women to engage in daily wage labour, such as selling products in local markets. Women are largely responsible for sourcing and preparing food for their immediate, and sometimes extended families, and may therefore feel the pressure to generate income more strongly to fulfil this domestic responsibility. In many villages, women brought their children with them while they fulfilled daily wage labour, yet men, who often sought daily wages through construction work, rarely did. Again, mothers therefore, face the additional challenge of juggling child-rearing responsibilities with practicing livelihoods. This is likely to continue as the need for additional income generated by women increases in the face of continued agricultural losses due to climate change.

Children are also increasingly involved in agricultural work in the majority of locations in Chiang Mai and Chiang Rai. Both boys and girls are required to help their parents, often their mothers, on the farm. While farm labour is often practiced on weekends by children, it is also practiced before and after school, which may have negative consequences for children's education. For example, children who have to wake up very early to work on farms may suffer from a lack of sleep, have poorer school attendance and performance, and impaired cognition. This may have more severe consequences for girls who traditionally received lower investments in education by their families than boys (Curran et al., 2003). Additionally, farm labour may have implications for children's physical well-being due to the strenuous inputs required for agricultural activities, as well as for their emotional well-being due to a lack of free time. Further empirical research would be needed to explore and validate these potential linkages.

5.3.3 Food and nutritional security

“During times of water scarcity meal time can be delayed because we have to go further to collect water from different sources”

(School girl, grade 6)

Many households grow rice and vegetables for household consumption and supplementary income^{8,10,12,13,17,19,24}. For children, schools are an important provider of free food, particularly for children from poorer families who cannot always provide enough food³.

During the rainy season, storms, heavy rains and landslides often damage crops grown in communities and schools^{1,4,13,17}. This leads some to buy additional products at an inflated price such as rice¹⁷, but also reduce intake of other foods such as vegetables^{3,30}. These foods are sometimes replaced with more affordable but less nutritious foods like dried noodles or taro both

at home and at school^{3,31}. At school, students occasionally have to bring their own rice from home⁴². Others might take food supplies home with them during the school holidays¹.

A decrease in income at certain times of the year, typically the dry season, means less money available for purchasing food³⁶. At the same time, food prices often increase^{10,39}. During such times, some reduce meat¹² and vegetable consumption^{1,38}. In many villages, adults and children have noticed a reduced crop in home gardens (rice and vegetables) recently due to a lack of water and heat stress, and now purchase more vegetables instead, if they can afford to^{12,19,24,28,37}. However, some are concerned about the safety of food grown locally¹⁰.

Some teachers noted a prevalence of underweight and malnourished children at some schools, with poorer students from migrant families more acutely affected^{1,2}. During rainy season, some children show signs of malnutrition such as rashes around their mouths³. Some children complain of hunger³⁰. At two schools, some children return to school after the holidays underweight or malnourished; thought to be more so boys than girls¹, and mostly from the poorest households³⁰.

5.3.3.1 Implications for young women and girls

Achieving food and nutritional security is a challenge exacerbated by climate change. In villages in Northern Thailand, food and nutritional security is tied to local subsistence farming as well as supplementary purchases of dried foods, meat and some vegetables. Most households are not able to maintain food security all year round due to unstable incomes and fluctuating sale and purchasing prices. Food safety is also a concern for some households, but there is a lack of evidence of the health impacts of chemical and pesticide use in these areas. Maintaining nutritional security appears to be an even greater challenge as households can typically not afford to provide everybody with nutritious, well-rounded diets. A lack of information and education on diet and nutrition also drives high rates of malnutrition. The health impact of malnutrition is likely to have an increased impact on young pregnant women and girls and/or young mothers at different lactation stages.

Climate change is having a double impact on food and nutritional security in all villages. During the rainy season, more intense and unpredictable rains are damaging or destroying crops grown in villages and schools. During the dry season, a lack of water coupled with extreme heat is causing reduced yields and crops to die from heat stress and dehydration. Food consumption is reduced and expensive nutritious foods are replaced with more affordable but less nutritional products. In school and villages, girls and boys, particularly poorer children from migrant families, show signs of being underweight and malnourished. As climate change continues to cause extreme weather and intensification of seasons, food and nutritional security will remain a significant challenge for households. Children, whose development depends on a healthy and balanced diet, stand to lose out as a result of this trend as families seek additional support to make ends meet. Girls remain particularly vulnerable as they are often the last member of the household to eat and the first to go hungry when food is in short supply.

5.3.4 Health

“I feel sick when it’s hot and there is no water”

(School girl, grade 6)

Different health risks exist in communities and schools, and primarily relate to water, sanitation and hygiene (WASH), sexual and reproductive health and rights (SRHR), air pollution, and diet and nutrition (see ‘food and nutritional security’ section).

Many communities do not have secure access to clean water. Perceived health impacts from the consumption of poor quality water are water-borne diseases like hepatitis A and stomach bugs from parasites^{12,30}. Some people believe the primary cause of contaminated water supplies to be run-off of pesticides/insecticides used in nearby farms^{1,2,15,22}. Some have no choice but to source water from contaminated canals and ponds²².

In some communities, women and children regularly bathe and wash clothes in contaminated rivers and streams to conserve household water during the dry season, which causes skin infections^{12,13,24,31}. This causes some children to miss school to prevent the spread of infection. In another case, schools had to resort to washing dishes in contaminated river water during a water shortage in the dry season²². Another health impact on young women of reduced water supply during droughts is personal hygiene during menstruation because of insufficient water for toilets.

During dry season water shortages, one strategy for reduced water consumption is to bathe and wash less, which increases hygiene and sanitation risks^{7,22,29,42,43}. In one case, ten students had an infectious rash and the school closed for three days to prevent its spread and to decontaminate the school¹. The perception is that boys are at higher risk as they typically have worse personal hygiene than girls^{2,29}. Young children, particularly from poor families are affected more²². Some children complain of feeling sick when it is hot²⁴. In another case, some children had skin infections from not washing regularly during a cold winter spell²⁰.

Seasonal burning of rice straw increases air pollution in most areas. Thailand banned agricultural burning three years ago, but neighbouring Myanmar still conducts this agricultural practice³². Children are at high risk^{12,17}. Girls, boys and young women developed coughs and respiratory problems from pollution and smoke inhalation from local fires^{2,6,11,29,31}. Children and young women that are exposed to pesticides without protection (i.e. face-masks, gloves) are at greater health risk^{22,43}. One young woman reported getting headaches when working with pesticides³⁶.

5.3.4.1 Implications for young women and girls

Young women and girls are exposed to various health risks that are likely to be exacerbated by climate change, such as related to WASH, air pollution and diet and nutrition. A key driver of WASH risks is the widespread lack of secure access to clean, safe water for consumption and household use; a risk which is heightened during dry season water shortages. Girls are particularly vulnerable, given the need for safe water for SRHR purposes and also due to the fact that they are more likely to support mothers with water-dependent household roles which increasingly rely on unsafe sources of water. For example, in several villages skin infections were reported which appear to be correlated with i) exposure of the skin to hazardous waters during bathing, washing clothes and collecting water from contaminated rivers, streams and dams, and ii) reduced bathing to conserve water. For some girls and boys, illness and infections compromise their educations. Overall, increased health risks – associated with water scarcity – are shouldered

by young women and girls. Climate change risks intersect with ethnic community cultural norms and local knowledge on sanitation, hygiene and particularly SRHR.

Air pollution, i.e. haze, caused by agricultural residue burning during the planting season was commonly raised as a climate change issue perceived by young women and girls. While the direct link from such practices to climate change is not clear, nevertheless it is an important environmental concern that is causing discernible health issues. Those that work outside, i.e. on farms, are acutely exposed to the haze and are at higher risk of smoke inhalation which has respiratory health risks for adults and children. In many cases, therefore, it is women and children that are at greater risk. Further, the exposure is not limited to farmers; several schools reported being affected by fires and smoke for which children are particularly at risk given that their lungs are not fully developed.

5.3.5 Education

“The school had to close for two days when an infection started spreading among the students. The cause was a lack of water at home for bathing and personal hygiene”

(School teacher)

Elementary education covers grades 1-6 (G1-G6) which is typically up to 12 years old. For ethnic minorities without citizenship and an ID card, access to further education is more difficult and often more disrupted^{12,15,29,42}. In at least one village, a number of children never attend school³². Some students that have completed elementary education in Myanmar must recommence education in Thailand at Kindergarten or G1 in order to learn Thai language^{2,3,22,30,42}. For many students, Thai is not their first language and is not spoken at home, and so learning tends to be more of a challenge^{15,29,42}. In some areas, children are taking additional evening classes to learn Chinese language^{7,19}. After elementary education, children will either attend secondary school, take vocational courses or drop out of school, despite education being compulsory until grade 9 (i.e. lower secondary level), age 15, for Thai citizens.

In some villages, not all children under the age of 12 are attending elementary school^{15,32}. Particularly for schools located near or along the Thailand-Myanmar border, girl and boy students may drop-out between years and return to Myanmar with their families^{2,15,23}. While in all locations teachers estimated that the majority of students continue education after elementary school, in some locations it is not uncommon for the education of girls to be prematurely ended by marriage and motherhood before completing G6 or in early teenage years^{2,15,22,32,34,36,38,42}. In others, girls had dropped out of school to work with their parents on the farm^{36,38,39}.

Children get to school either by road transport (i.e. school truck, motorbike) or by walking, some from mountainous communities^{1,14,16}. Journey times range from a 10-minute walk to a 30-minute drive; in some cases, the school or village head provides transportation free of charge, in other cases there is a fee³⁰. At one school, the majority of students live in dormitories on the school grounds¹. During storms in the rainy season, there have been occasions where flood waters have affected school buildings²³, tree fall or landslide has temporarily blocked road access to schools^{1,2,16,30}, and it is been harder to reach school due to flooded roads or landslides^{19,21,23,31}. Some believe landslides are a result of poor soil quality and deforestation for agriculture¹⁶.

Some children occasionally miss days of school due to weather and climate events. In a couple of cases, tree fall during storms cut power/electricity lines to schools for between a few hours and a few days^{1,2,15}. Children at one school felt that they missed no more than three days during the

rainy season⁴. Schools are closed for holiday during the height of the dry season. In the case of the school with dormitories, some students (and teachers) remain during school holidays too¹. In winter, very cold temperatures have occasionally caused the school to close for between one and three days^{15,30}. In several cases, both boys and girls miss one to two days of school a week for a month in order to help their parents and relatives on the farm during harvest seasons^{15,16,23,29,41,42}.

5.3.5.1 Implications for young women and girls

Girls' and boys' access to education is integral to their resilience and ability to adapt to climate change, now and in the future. Among ethnic minority communities in northern Thailand, however, access to education is not guaranteed because they are not recognized as citizens of Thailand without an ID card, which many do not possess. Elementary schools are generally able to reach and educate children from these communities until grade 6 (aged 12), but the average school-leaving age is between 12 and 15. Further, students might require extra learning support when their first language is not Thai. Girls and boys are mostly unable to access the higher and further education that has the potential to empower them as young adults.

In some parts of Chiang Mai and Chiang Rai, girls' participation in education is tied to early marriage and parenthood in mid- to late-teenage years. It is also around this age that girls and boys leaving school transition from part-time support to their parents on the farm to full-time work, most likely in farming but possibly also in day-labour construction or factory work. Another factor behind school drop-out and absenteeism is economic migration; families from ethnic communities often migrate for work either locally within Thailand or internationally to Myanmar where the family may have originally emigrated from. Disruption or early-ending of education is likely to have long-term implications for resilience and adaptive capacity.

Climate change is affecting the lives of girls and boys now. For example, heavy rains, floods, and landslides can make school more difficult to reach, and some children might miss several days of school due to blocked routes to school, damage at home or damage at school. As observed by some informants, the increasingly unpredictable and extreme weather conditions will further affect access to education and cause additional stresses. This is likely to acutely affect girls as any additional household burdens during times of greater need will fall first on them.

5.3.6 Migration

“Since my husband has left home, I have more work because I now also do the tasks he used to do, like repairing water pipes”

(Young woman)

In Northern Thailand, there appear to be some link between climate change and rates of migration, yet further empirical research is required to more clearly define and understand this relationship. Declining agricultural productivity due to climate change was present in all of the locations in Chiang Mai and Chiang Rai, yet only in some cases did climate change appear to be a cause of economic migration. This points to the existence of other social, cultural, economic and political factors that may influence decisions to migrate.

Rates of migration, as perceived by villagers, varied considerably between locations. Initial insights reveal that ethnicity and related cultural norms may play an important role in decision-making on migration in Northern Thailand, and members of certain ethnic groups may be more or less inclined to move based on prevailing practices, beliefs and norms. For example, Lahu ethnic communities seem to experience extremely low rates of out-migration despite facing

considerable economic challenges due to agricultural losses^{12,34}. Members of Lahu communities generally discourage young people from migrating, especially young women, who they fear will be forced to turn to prostitution or working in bars due to low levels of education³². Despite high rates of poverty and difficult living conditions, young Lahu women themselves express a strong preference for staying in their home villages^{34,36}. This stated preference by young women closely corresponds to Lahu cultural norms in which young women are generally expected to stay in their village after marrying, even if their husbands come from a different village or city^{28,32}. In instances where members of the Lahu ethnic community do migrate to cities, they typically move together as a family. Outmigration of young females alone is rare³².

In the villages of other ethnic groups, such as Thai Yai, Akha, Lisu, Dara-Ang, rates of migration appeared higher, but varied considerably between young men and young women. In some communities, out-migration of young men seeking employment opportunities in cities such as Bangkok, Chiang Mai, Chiang Rai or Fang is relatively common. These men were often previously farmers and migrated to find employment in construction or the tourism sector^{8,10,11,17,30}. The outmigration of men has resulted in increased workloads for young women in villages who now not only bear the responsibility for all childcare and household labour, but also for village maintenance work, such as repairing water pipes, which was previously done by men¹¹. In addition, young women are increasingly expected to earn money through paid labour to contribute to household income, in addition to the large amounts of unpaid household labour that they are expected to do^{9,38,39}. This trend is likely to continue given the increase in single, female-headed households in some villages in Northern Thailand due to male out-migration.

Out-migration of young women also occurs and is even sometimes perceived to be more common than young men, particularly in predominately Thai villages that are located closer to urban centres³⁹. Young women are often attracted to the idea of moving to cities because they feel that they will have more freedom from their families and increase their decision-making power³⁹. Moving to cities also represents an opportunity to pursue non-agricultural employment and achieve economic independence, as non-agricultural income-earning opportunities in rural areas are largely perceived as being male-dominated, e.g. mechanics in auto repair shops³⁹. In cities, young women often pursue jobs as waitresses, domestic workers, shop attendants, or factory workers^{12,17,39}. However, young women's ability to migrate appears to be closely tied to marital status. It is primarily, young, unmarried women that migrate, and those that are married rarely leave their villages¹⁷. This is in contrast to men, including young men, that seem to migrate, irrespective of marital status. Having children appears to be less of a hindering factor to migration than being married, as there are cases of single mothers migrating to cities and leaving their children in the village to be raised by their grandparents³⁹.

Migration can have multiple impacts on children. Firstly, the out-migration of parents who seek alternative livelihoods in cities can lead to distress due to separation and cause a lack of emotional support for children. It can also lead to increased responsibilities placed on children, often girls, to fulfil household labour needs, particularly in single parent-headed households¹⁹. The increased workloads of girls can compromise time available for education and school performance²³. Secondly, some agricultural workers migrate within Northern Thailand to work seasonally on different crops. In some cases, families move with their children which interrupts educational continuity. For example, some children move with their parents to work on tangerine farms in different parts of the region, taking one semester off from school to earn an income with their parents⁴². Upon returning to their villages, these children are required to repeat the semester in school, causing them to fall behind their peers⁴².

5.3.6.1 Implications for young women and girls

While studies on the links between climate change and migration is increasing, it is still an emerging, and often debated, area of research. The extent to which climate change is a cause of migration, and if migration can be seen an adaptation measure, remains to be explored. Longer-term studies should investigate the gendered causes and implications of migration for young women, young men, girls and boys in the context of climate change in more depth.

In Northern Thailand, gender, age, ethnicity, socio-cultural practices, including in relation to marital status, appear to play an important role in shaping migration rates among farming communities. Intersecting social, cultural, and economic factors create differential potential for migration among men and women of various ethnic backgrounds. The lower rates of migration among some ethnic communities appear to be largely driven by social norms that discourage migration, particularly of young married women. The generally young age of marriage in these communities, often around 12-14 years old restricts the mobility of young women, while also having clear implications for their education and future employment opportunities.

The higher prevalence of migration in other ethnic communities is also linked to social and cultural dynamics, including gender norms, but is also motivated by economic factors. The relatively high rates of out-migration of young, married men who were previously struggling farmers, creates a shortage of male labour, particularly on farms. The wives, daughters, and other female relatives of young men who migrate are largely responsible for making up for this lost paid labour, as well as unpaid labour such as repairing infrastructure. The increase in female-headed households in due to male urban migration means that young women are increasingly responsible for paid labour, unpaid household labour, as well as unpaid male village labour. The reliance of mothers on their children, especially their daughters, to support them in handling their workloads, which are even heavier in single-parent headed households, represents another potential layer of climate change impacts on young women and girls.

While generally less common, female urban migration was largely seen by young women as an opportunity to find non-agricultural employment and to gain more decision-making power and financial independence. The lack of alternative rural income-earning options available for young women, and the desires of young women to have greater independence, shed light on the potentially restrictive nature of the prevailing sociocultural and economic structures in place in the region for young women. Similarly, the lower rates of migration among young married women, but not young married men, illustrates the role that marital status appears to play in influencing migration decisions for women, but not for men. As a result, young married women generally have more unequal opportunities for mobility compared to their husbands, which limits their ability to pursue employment in urban centres.

Even if children do not migrate themselves, they can be greatly impacted by migration. They may experience emotional stress from long-term separation from their parents who have migrated. The absence of one, or both, parents can also increase the workloads of children as they must make up for lost adult labour, both on farms and in the household. Girls are particularly affected by this as they often closely support their mothers with time-intensive household labour. The additional labour needs placed on children in migration-affected households may have implications for education, particularly for girls. For example, some girls are required to bring their younger siblings with them to school because there is no one to watch them at home. This compromises their ability to focus on learning while in the classroom. Furthermore, migration of parents can lead to serious child protection issues. For example, girls who have been left to live with relatives, neighbours or family friends may be at greater risk of sexual abuse and may be less likely to report it without their parents around.

Children that migrate with their parents seasonally face major educational disruptions, creating serious education inequalities between children from migrating farming families – who are often very poor – and children that do not need to migrate. Girls are likely to be particularly affected by this as family educational investments in girls are traditionally lower than in boys, potentially making it more difficult for them to catch up with their peers. As the need to migrate seasonally for income is likely to continue under climate change, the long-term educational impacts this has for children, and how boys and girls may be affected in different way warrants further investigation.

Table 4. Summary of climate change vulnerability and impact results, and implications for young women and girls, per sector

Sector	Vulnerability and impacts	Implications for young women and girls
Water security	<ul style="list-style-type: none"> • Most communities source water from natural sources (e.g. mountain springs; groundwater wells) for local storage and household use • To some degree, all communities and schools suffer from a lack of sufficient quantities of water for drinking, bathing, household use, and irrigation, at certain times of the year, but particularly during the dry season • Some communities also have concerns over the quality and safety of water used for household consumption • As a result, water consumption is reduced and many are forced to find alternative household water sources and purchase drinking water from water companies, placing a further financial burden on households • Access to water within communities is typically not equitable and can reflect underlying power dynamics; distribution is decided by village heads and committees, and not all houses have direct piped supply or access to water storage facilities 	<ul style="list-style-type: none"> • Water access and security in the context of climate change is a major challenge faced by all communities, to varying degrees, that has worsened in recent years • Acute water insecurity during times of scarcity has clear impacts on young women and girls in terms of household and job roles, education, health, food and nutritional security, livelihoods, and migration • The burden of water insecurity falls predominantly on women, who are largely responsible for sourcing water for household consumption and are sometimes required to travel to find alternative sources (e.g. rivers) on a daily basis • Alternative sources of water are sought for bathing and household chores, but are often unsafe and can cause health problems for women and children • Girls are more likely than boys to support their mothers in sourcing water and assisting with household chores, and the time burden and associated risks increase during times of scarcity • At school, water consumption is also reduced during times of scarcity, which can have sanitation and hygiene impacts, with girls' facing additional SRHR risks
Livelihoods	<ul style="list-style-type: none"> • Agriculture is the primary livelihood for all communities and most households – some own farmers, some are day-labourers, some work on Royal Project plantations 	<ul style="list-style-type: none"> • Both adults and children perceive that climate change is negatively impacting farmers' livelihoods • During the rainy season, floods, storms and landslides can often block access roads, damage

	<ul style="list-style-type: none"> • A general decline in income from farming has led to an increase in seeking alternative sources of income outside of the community, e.g. construction, manufacturing and service sector jobs, which typically require some travel and/or migration • In search of sufficient/additional household income, children are supporting their families by working on farms, particularly after school, at the weekend and during school holidays • Women face increased burden to source income and food to support immediate and sometimes extended families 	<p>crops and kill livestock; reducing yields and revenue</p> <ul style="list-style-type: none"> • During times of water scarcity and extreme temperatures (i.e. heat stress) crop quantity and quality is compromised, reducing yields and revenue • Reduced/insufficient household income due to climate change increases the pressure on women and children to support in generating income, which doubles women's responsibilities and can compromise children's education
Food and nutritional security	<ul style="list-style-type: none"> • Households grow rice and vegetables for household consumption to supplement purchased goods. Schools are an important provider of daytime meals for children, particularly for children from poor families • Generally, many are not able to maintain food and nutritional security all year round due to insecure incomes and fluctuating prices • During times of insecurity, food consumption is reduced and expensive nutritious foods are replaced with more affordable but less nutrition products • Food safety is a concern for some, partly due to pesticide use on farms 	<ul style="list-style-type: none"> • During times of water scarcity, when household incomes are typically down and food prices are inflated, less money is spent on nutritious food, particularly meat and vegetables • At the same time, a lack of water means a reduced yield from household gardens (i.e. rice and vegetables) • During the rainy season, floods, storms and landslides can often damage crops grown in communities and schools • Some children, particularly poorer children from migrant families, show signs of being underweight and malnourished, more so during times of water scarcity
Health	<ul style="list-style-type: none"> • Health risks associated with safe water, sanitation and hygiene (WASH), air pollution, and diet and nutrition (see 'food and nutritional security') • Many communities do not have secure access to clean, safe drinking water and some are affected by 	<ul style="list-style-type: none"> • Generally higher sanitation and hygiene risks during dry season water shortages as less water for bathing is available

	<p>water-borne diseases, which are partly attributed to water contamination by pesticide run-off on farms</p> <ul style="list-style-type: none"> • Seasonal burning of rice straw in Myanmar and Thailand increases air pollution, causing coughs and other respiratory problems from pollution and smoke inhalation, for which children are at higher risk • Adults and children working with pesticides on farms without protection are exposed to associated health risks 	<ul style="list-style-type: none"> • During times of water scarcity, girls and young women face SRHR-related risks due to reduced water supply for sanitation and hygiene • During times of water scarcity, due to a lack of water at home, young women and children bathe and wash clothes in contaminated rivers, causing skin infections
Education	<ul style="list-style-type: none"> • Children from ethnic minority communities are engaged in both formal (i.e. the national system) and informal (i.e. evening classes) education • For ethnic minority children without Thai citizenship or a Thai ID card, access to education can be difficult • Drop-out and absenteeism is linked to migration; either local or international (i.e. to Myanmar) • Girls not attending secondary school and further education is linked to marriage and/or motherhood in teenage years 	<ul style="list-style-type: none"> • Girls occasionally miss several days of school due to extreme climate events • During the rainy season, floods, storms and landslides can make schools harder to reach for girls, boys and teachers
Migration	<ul style="list-style-type: none"> • Men are increasingly engaging in temporary or semi-permanent migration in search of alternative sources of income, typically to work in urban areas in construction, manufacturing and tourism (e.g. in Chiang Rai, Chiang Mai, Bangkok) • The migration of men increases the burden on women in terms of farm work, household roles and childcare • Women often must also find sources of income as the income earned by men may only be accessed 	<ul style="list-style-type: none"> • Economic migration is being driven by declining incomes from agriculture, partly associated with recent periods of water scarcity and impacts on crop yields and revenues • Migration can increase the climate vulnerability of girls in particular in terms of disruption to education, emotional distress, lack of support networks, and increase in household and caregiving responsibilities

	<p>when they return to the community after weeks or months of being away</p> <ul style="list-style-type: none">• Women may also be increasingly looking to economic opportunities outside of their communities; some are finding work in factories, restaurants and as domestic workers	
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5.4 Adaptation

“I’ve learned a lot about climate change at school and shared information with my parents, but I still feel like they haven’t taken any action”.

(School girl, Grade 5)

While the impacts of climate change are widely felt by community members in the locations studied in both Chiang Mai and Chiang Rai, community members generally feel that they do not have sufficient knowledge on the causes of climate change, nor on how to adapt to it^{1,12}. Some village residents have attended trainings on climate change, yet there are still significant gaps in awareness and capacity to adapt to climate change. Nevertheless, community members have taken a range of actions to try to adapt to a changing climate in Northern Thailand. Crop diversification to include more drought-tolerant crops¹², use of fertilizers⁷, water rationing¹⁷, and investments in pipes to directly connect to water sources¹⁷ are some of the adaptation measures that have been taken in the target locations. External support has also been provided to farmers to deal with climate change impacts. For example, the government occasionally provides pay outs to farmers if their rice fields are damaged by floods or droughts³⁷, or the municipality may provide a tractor to villages to help clear the road following landslides¹⁶. Some villagers also receive emergency information on climate-related risks through a village loudspeaker¹⁵ or through the village head who shares the information at community meetings¹¹.

People in one Chiang Rai village expressed their desire to be able to better adapt to climate change. In particular, they would like to receive support to grow crops that are less likely to be impacted by climate change, e.g. drought-resistant crops⁷. To do this, they would like to receive seedling support from the government as they often cannot afford the inputs needed for crop diversification. In one Chiang Mai village, local farmers highlighted the lack of crop insurance as a barrier to adaptation³⁷. The process for buying agricultural insurance was seen as being “complicated and requiring a lot of paperwork”³⁷. Low levels of education among rural farmers in the region may make navigating complex insurance documents challenging, particularly as some farmers, especially older men and women, were illiterate in several of the villages.

5.4.1 Adaptation among young women

Many of the young women interviewed were not confident about what climate change is^{13,33,35}. Engagement in adaptation-related activities was mixed both within and across villages: some young women had attended trainings^{9,19,40}, for example on crop diversification, or to increase their knowledge on crop seasons in the context of climate change¹⁰, while other young women had never attended trainings or even received any information on climate change^{8,26,33}. Some of the young women who had never participated in any climate change related activities expressed lower levels of awareness on the importance of climate change⁸, and were less aware of any ongoing activities or discussions in their villages on how to address climate change impacts, for example on dealing with water shortages²⁶.

Some young women were aware of their children learning about climate change in school but seemed to be largely unaware of the details of what they were learning^{8,13}. The young women that did have some levels of awareness of climate change and how to adapt to it, still appeared to have relatively limited knowledge on it. For example, one woman highlighted that adapting to climate change could be done by “using less chemicals on farms”⁴⁰ but did not seem to fully understand the nature of climate change risks and impacts, and ways to adapt to it.

Access to emergency information on climate-related risks was also mixed among young women, including within villages. For example, one young woman in one village in Chiang Rai said she was unaware of any climate-risk warning systems that existed in her village⁸. However, another young woman in that same village said that the village head provides such climate-risk warnings in meetings¹¹. The differential awareness of, and access to, such information raises questions of equity which may be driven by different social positioning of young women and their connections within the village.

Although levels of climate change and adaptation are generally low in the locations visited, many young women expressed interest in learning more about climate change, and how to adapt to it in the future^{9,11,19}. Some young women stated a preference for learning about climate change through hands-on, outdoor experience¹⁹. Specifically, young women would like to gain more knowledge on how to address water shortages during droughts^{8,35}, the potential health consequences of climate change^{26,40}, and the impacts of climate change on crops⁴⁰. Some young women felt that they were more interested in learning and taking action on climate change than young men in their community¹⁹.

Some young women highlighted current and potential future barriers they may face in learning about climate change and shaping adaptation strategies. One young woman said that although she would like to learn more about climate change, she is concerned about the time investment needed for attending trainings on adaptation⁸. Similarly, another young woman cited the need to take care of her children as a barrier to attending any future trainings on adaptation⁹. She also recalled how she tried to share the knowledge she gained on adaptation after attending a training with others, but that she was not taken seriously⁹, which may have implications for her motivation to share knowledge in the future.

5.4.2 Adaptation among girls

Both girls and boys generally seemed more confident in describing what climate change is and how to adapt to it than young women and other community members in their villages. Many children were aware of climate change-related terminology such as 'global warming', and some could describe climate change impacts, such as how climate change can increase the severity of droughts¹⁴. One group of school children felt that climate change will create many problems for farmers, and therefore being a farmer would be an even harder job in the future¹⁴.

Access to emergency climate-risk information was more structured in some schools than others. In one Chiang Rai school, a loudspeaker is used to share emergency information to students and teachers. In case of power outages, the school has a contingency plan in which a warning bell is rung and then number of rings indicates what actions students and teachers should take³. In some schools, there is no formalized emergency warning system, and students and teachers must rely on the information shared through a loudspeaker from nearby villages^{1,15}. However, the children at one school come from a variety of ethnic groups and therefore not all of the children can understand the information being shared¹⁵.

All of the schools visited were part of Plan International's Child-Centred Climate Change Adaptation (4CA) programme which helps to explain higher levels of climate change awareness among children. Nearly all of the children that were invited to participate in the research activities were either currently or had previously been involved in adaptation activities through their schools. Climate change lessons had been integrated into the existing curriculum in three of the six schools visited, one in Chiang Rai and two in Chiang Mai^{20,24,29}. In another school, adaptation was taught as a supplementary course to students but had not been formally integrated into the school's curriculum, although teachers would like to see this occur in the future^{1,3,4}. A range of learning materials that use multimedia, e.g. photos and videos, have been developed by some schools to help teach students about climate change¹⁶. The majority of students had also attended adaptation trainings at their schools which introduced

a range of adaptation measures to students^{14,16,20,29}. Adaptation training topics were developed jointly by students and teachers in some cases³¹, and by the school principal and Plan International Thailand project teams^{1,2,6}.

Some of the adaptation measures introduced include:

- Building check dams to prevent erosion³¹;
- Planting trees and grass to protect from landslides³¹;
- Practicing water conservation^{16,31};
- Installing sandbags as a flood defence²⁴;
- Growing vegetables in school gardens for the school canteen to cope with rising food prices in markets^{23,24,29}.

Students also received more general training to increase their environmental awareness. Environmental protection measures introduced to students at schools include:

- The development of an environment learning centre²³;
- Use of cloth bags instead of plastic bags³¹;
- Prevention of deforestation³¹;
- Production of organic fertilizer and compost to use in school gardens^{2,6};
- Cycling instead of driving³¹;
- Recycling and waste separation^{24,29,42}.

Since learning about climate change at school, many children now feel better equipped to adapt to climate change. Many of the girls, in particular, expressed increased confidence in adapting to climate change⁵. A number of teachers felt that girls show more interest in learning about adaptation than boys and in engaging in outdoor adaptation training activities, and typically ask more questions during class^{2,3,42}. Furthermore, girls appear to share more of the knowledge they've gained on climate change with their families, including on seasonal changes influenced by climate change^{3,4,5,14}. However, some girls feel that their parents haven't taken any action to adapt to climate change or prepare for disasters despite sharing knowledge with them⁵. Another girl expressed that although she has gained knowledge on adaptation, she doesn't feel comfortable talking to adults, including her parents, about it yet⁵.

Both boys and girls in all schools expressed a desire to learn more about climate change impacts and adaptation at school. Many children would like hands on experience on "how to adapt"²⁰, with a strong preference for learning outdoors⁵.

There was particular interest in learning more about the following topics:

- Building check dams in nearby rivers with sandbags and bamboo to collect water for use by the school and village¹⁶;
- Tree planting to stabilize soil and reduce landslide risk⁶;
- Water storage, e.g. ponds, and water purification system¹⁶;
- Making organic fertilizers for crops²⁰.

Students also expressed a desire to learn more about waste management, tree planting, and building greenhouses for their school gardens^{5,16,24}. While teachers are generally very supportive on increasing students' knowledge on adaptation, challenges and needs were highlighted by some teachers in order to provide students with the knowledge and skills they

need. These include: needing to improve teachers' knowledge on climate change and adaptation so they can confidently share knowledge with students²⁹; developing adaptation learning materials in multimedia formats, e.g. videos to better engage students²⁰; and creating dedicated adaptation learning spaces for students within schools²⁰.

5.4.3 Implications for young women and girls

Knowledge on climate change is relatively limited in all communities studied in Chiang Mai and Chiang Rai. Despite some participation in some trainings in the past, there was a general recognition by community members that their climate change knowledge needs to be expanded in order to further develop the skills needed to adapt to climate change. People had made attempts to adopt small-scale adaptation measures which shows reliance on locally-developed, village-led adaptation initiatives, rather than on formalized adaptation support from external actors, such as the government or non-governmental organizations. The adaptation needs identified by community members were largely linked to support for their agricultural livelihoods which are greatly suffering under climate change. The government was identified as a desirable provider of adaptation support for farming communities.

Similar to the general population within villages, young women had relatively low levels of climate change knowledge. Only some young women had attended adaptation trainings in the past which highlights the unequal distribution of climate change learning opportunities in the target locations. In some cases, young women that had not participated in any climate change trainings or activities appeared to be less aware of the potential severity of climate change impacts and said they were "more concerned with day-to-day challenges". However, the daily challenges they highlighted were linked to water scarcity. This illustrates the lack of awareness on the linkages between water supply and climate change among some young women, particularly those who have not received any trainings. These women also appeared to be less aware of any ongoing village adaptation initiatives or village emergency warning systems. This highlights the possible inequitable distribution of, and access to, critical information in some villages which can lead to different adaptive capacities among young women, in which those who are better connected in the village have higher adaptive capacities.

The stated adaptation needs and desires of young women in the target locations were largely related to their farming livelihoods, access to water and health. The high levels of motivation of young women to learn more about adaptation should be capitalized on in future adaptation interventions. Young women should be empowered to become adaptation leaders within their communities, particularly as young women are often well-placed to understand the needs of their entire household, including the needs of girls. However, future interventions must also consider the time constraints that attending trainings can place on young women who are often already balancing a heavy load of household and farm work. In particular, young women's responsibility for caring for children can be a barrier to attending trainings. Trainings should be held in child-friendly spaces so that young women can bring their children or younger siblings with them.

In contrast to young women and adults, the general confidence of children to talk about climate change illustrated the benefits that regular climate change trainings at schools can have. The interactive, outdoor activities used to teach children about climate change at schools gave children a positive impression of taking climate action. In all schools, girls showed more interest than boys in learning about climate change, highlighting the important roles that girls can play as climate leaders. The higher levels of awareness on climate change impacts and potential adaptation measures made children, especially girls, feel better-equipped to address climate change in the future. However, there may be some equity concerns in terms of accessing knowledge and learning opportunities. In some schools there were children from several ethnic groups who have different first languages. Children from minority ethnic groups may face barriers in having equal access to information as children from other ethnic groups who speak

the dominant language. This includes access to emergency climate-risk warnings, which are critical for the safety of boys and girls of all ethnic groups.

Boys and girls are both motivated to learn more about climate action. They can serve as future climate action leaders in the future but can also play an important role now by sharing the adaptation knowledge they have learned at school with their parents, many of whom have never attended adaptation trainings. Many girls, especially those who come from farming families, are eager to share climate knowledge with their parents to support them. However, confidence-building activities could be done at school to build the self-esteem of girls and empower them to share climate knowledge with their parents and other adults. Other adaptation needs identified by children relate to improving water collection and storage, increasing farming productivity, and reducing environmental hazard risk. These closely correspond to key climate change impacts occurring in their villages, illustrating children's awareness of the challenges being experienced by their communities.

RECOMMENDATIONS

We suggest the following principles for targeted action on climate change that builds the resilience of young women and girls. These principles (adapted from UNICEF, 2015) should be integrated into all efforts, including across all the specific set of recommendations we make below these principles.

Principles for strengthening adaptation and resilience of young women and girls

- Protect and promote the rights of children and their families who are impacted by climate change.
- Prioritize the needs of the most vulnerable in adaptation efforts.
- Reduce gender, age, ethnicity and social inequities.
- Listen to and act on children's perspectives on climate change.
- Educate children and youth on climate change.
- Align action on adaptation, in different sectors and at all levels.
- Invest in children in plans to tackle climate change.
- Scale-up proven approaches to address the changing needs of children.

1. Provide girls with access to education to support climate action and participation

- Design gender-sensitive educational programmes on climate change that helps girls better understand the climate change risks they face now and in the future, and the steps they can take to adapt to, and manage these risks.
- Strive for equal completion of quality, inclusive education for boys and girls, including those of ethnic minorities, so that they have the same opportunities for learning and developing critical skills which will support equal participation in climate change action.
- Ensure both boys and girls develop a shared understanding of the risks they each face in the context of climate change, which may be the same in some cases and different in others, to ensure the next generation of adults will have a gender-responsive understanding of climate change and how to adapt to it.

2. Empower young women and girls towards leadership in climate action

- Create safe spaces to empower young women and girls, including those from ethnic minorities, to voice their opinions and be encouraged to participate in planning at different levels.
- Build capacities in order to strengthen girls' self-esteem, their abilities to advocate for change and their potential for leadership, with buy-in from community leaders.

3. Support young women and girls towards sustainable livelihoods that build resilience

- Support income-generating opportunities that allow young mothers, particularly in single-parent households, to provide for their families in the context of climate change.
- Develop girls' life skills for a green economy and support green skills vocational training for girls and young women through tailored education programming, including training in minority languages for girls young women from different ethnic groups.
- Education actors focus on girls' life skills development and on supporting girls in science, technology, engineering, and mathematics (STEM) career fields.

4. Ensure social safety support nets for young mothers and girls affected by migration

- Conduct research on the social and economic needs of families affected by migration, specifically those who have been “left behind”.
- Explore the potential of welfare systems and/or the existing rural social safety nets of different ethnic groups to better support female-headed households, particularly those headed by young single mothers, in relation to childcare, income generation, and access to health and social services.

5. Actively respond to young women’s and girls’ needs in natural and water resource planning

- Natural and water resource planning at local levels must better and more actively consider and respond to the uses and needs of women and girls, including those from ethnic minorities.
- Put in place institutional mechanisms to ensure the equitable distribution of resources, by which decisions are made by all those that stand to be affected, and not just by traditional power structures.
- Invest in safe and sustainable water sources and infrastructure for all that meet the future needs of women, men and children under a changing climate, including drinking, household, school and irrigation uses of water.
- Explore the potential of rainwater harvesting and other means of securing safe water supplies for the most vulnerable without increasing financial, resource and time burdens on women and girls that have traditionally been tasked with sourcing water for the household.
- Monitor water quality and take action against farm chemical contamination of rivers that is causing health problems predominantly in women and children who use contaminated water sources without any alternative.

6. Design interventions that ensure young women and girls are able to lead healthy lives in the face of climate change

- Ensure the affordability and accessibility of safe, nutritious foods for young women and girls.
- Invest in nutritious meals at school to improve cognition and learning and reduce susceptibility to illnesses among children.
- Raise young women’s and girls’ awareness on the potential health impacts of climate change, including those related to water quality.
- Improve women’s and young girls’ access to quality, affordable health services, including those related to sexual and reproductive health issues which may worsen as a result of climate change. Health services should be provided in local languages to ensure accessibility for ethnic groups.

REFERENCES

- Andajani-Sutjahjo, S., Chirawatkul, S., Saito, E., 2015. Gender and Water in Northeast Thailand: Inequalities and Women's Realities. *Journal of International Women's Studies* 16, 200–212.
- Arora-Jonsson, S., 2011. Virtue and vulnerability: Discourses on women, gender and climate change. *Global Environmental Change* 21, 744–751.
<https://doi.org/10.1016/j.gloenvcha.2011.01.005>
- Asthana, A.N., 2010. Is participatory water management effective? Evidence from Cambodia. *Water Policy* 12, 149. <https://doi.org/10.2166/wp.2009.050>
- Bakker, K., Morinville, C., 2013. The governance dimensions of water security: a review. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 371, 20130116–20130116.
<https://doi.org/10.1098/rsta.2013.0116>
- Bartlett, S., 2008. Climate change and urban children. Impacts and implications for adaptation in low- and middle-income countries. (Human Settlements Discussion Paper Series). IIED, London.
- Black, R., Bennett, S.R.G., Thomas, S.M., Beddington, J.R., 2011. Climate change: Migration as adaptation [WWW Document]. *Nature*. <https://doi.org/10.1038/478477a>
- Boyd, E., Juhola, S., 2009. Stepping up to the climate change: Opportunities in re-conceptualising development futures. *J. Int. Dev.* 21, 792–804.
<https://doi.org/10.1002/jid.1619>
- Cardona, O.D., Van Aalst, M.K., Birkmann, J., Fordham, M., McGregor, G., Perez, R., Pulwarty, R.S., Schipper, E.L.F., Sinh, B.T., 2012. Chapter 2: Determinants of Risk: Exposure and Vulnerability, in: Decamps, H., Keim, M. (Eds.), *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC)*. International Panel on Climate Change (IPCC), Cambridge, U.K. and New York, NY, USA, pp. 65–108.
- Carr, E.R., 2008. Between structure and agency: Livelihoods and adaptation in Ghana's Central Region. *Global Environmental Change, Local evidence on vulnerabilities and adaptations to global environmental change* 18, 689–699.
<https://doi.org/10.1016/j.gloenvcha.2008.06.004>
- Carter, M.R., Little, P.D., Mogue, T., Negatu, W., 2007. Poverty Traps and Natural Disasters in Ethiopia and Honduras. *World Development* 35, 835–856.
<https://doi.org/10.1016/j.worlddev.2006.09.010>
- Cook, J.T., Frank, D.A., 2008. Food security, poverty, and human development in the United States. *Ann. N. Y. Acad. Sci.* 1136, 193–209. <https://doi.org/10.1196/annals.1425.001>
- Croppenstedt, A., Goldstein, M., Rosas, N., 2013. Gender and Agriculture: Inefficiencies, Segregation, and Low Productivity Traps. *The World Bank Research Observer* 28, 79–109. <https://doi.org/10.1093/wbro/lks024>
- Dankelman, I. (Ed.), 2010. *Gender and climate change: an introduction*. Earthscan, Washington, DC.
- Djouidi, H., Brockhaus, M., 2011. Is adaptation to climate change gender neutral? Lessons from communities dependent on livestock and forests in northern Mali. *The International Forestry Review* 13, 123–135.
- Ebi, K.L., Paulson, J.A., 2010. Climate change and child health in the United States. *Curr Probl Pediatr Adolesc Health Care* 40, 2–18.
<https://doi.org/10.1016/j.cppeds.2009.12.001>
- Egondi, T., Kyobutungi, C., Kovats, S., Muindi, K., Ettarh, R., Rocklöv, J., 2012. Time-series analysis of weather and mortality patterns in Nairobi's informal settlements. *Glob Health Action* 5. <https://doi.org/10.3402/gha.v5i0.19065>

- Eriksen, S.H., O'Brien, K., 2007. Vulnerability, poverty and the need for sustainable adaptation measures. *Climate Policy* 7, 337–352. <https://doi.org/10.1080/14693062.2007.9685660>
- Field, C.B., 2012. Managing the risks of extreme events and disasters to advance climate change adaptation: special report of the intergovernmental panel on climate change. Cambridge University Press.
- Field, C.B., Barros, V.R., Mastrandrea, M.D., Mach, K.J., Abdrabo, M.A.-K., Adger, W.N., Anokhin, Y.A., Anisimov, O.A., Arent, D.J., Barnett, J., Burkett, V.R., Cai, R., Chatterjee, M., Cohen, S.J., Cramer, W., Dasgupta, P., Davidson, D.J., Denton, F., Döll, P., Dow, K., Hijioka, Y., Hoegh-Guldberg, O., Jones, R.G., Jones, R.N., Kitching, R.L., Kovats, R.S., Lankao, P.R., Larsen, J.N., Lin, E., Lobell, D.B., Losada, I.J., Magrin, G.O., Marengo, J.A., Markandya, A., McCarl, B.A., McLean, R.F., Mearns, L.O., Midgley, G.F., Mimura, N., Morton, J.F., Niang, I., Noble, I.R., Nurse, L.A., O'Brien, K.L., Oki, T., Olsson, L., Oppenheimer, M., Overpeck, J.T., Pereira, J.J., Poloczanska, E.S., Porter, J.R., Pörtner, H.-O., Prather, M.J., Pulwarty, R.S., Reisinger, A.R., Revi, A., Ruppel, O.C., Satterthwaite, D.E., Schmidt, D.N., Settele, J., Smith, K.R., Stone, D.A., Suarez, A.G., Tschakert, P., Valentini, R., Villamizar, A., Warren, R., Wilbanks, T.J., Wong, P.P., Woodward, A., Yohe, G.W., 2014. Climate Change 2014: Impacts, Adaptation, and Vulnerability: Summary for Policy Makers of the Working Group II Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Intergovernmental Panel on Climate Change (IPCC), Cambridge, UK.
- Garschagen, M., Hagenlocher, M., Comes, M., Dubbert, M., Sabelfeld, R., Lee, Y.J., Grunewald, L., Lanzendörfer, M., Mucke, P., Neuschäfer, O., Pott, S., Post, J., Schramm, S., Schumann-Bölsche, D., Vandemeulebroecke, B., Welle, T., Birkmann, J., 2016. World Risk Report 2016. Bündnis Entwicklung Hilft and UNU-EHS.
- Grace, K., Davenport, F., Funk, C., Lerner, A.M., 2012. Child malnutrition and climate in Sub-Saharan Africa: An analysis of recent trends in Kenya. *Applied Geography* 35, 405–413. <https://doi.org/10.1016/j.apgeog.2012.06.017>
- Haines, A., Bruce, N., Cairncross, S., Davies, M., Greenland, K., Hiscox, A., Lindsay, S., Lindsay, T., Satterthwaite, D., Wilkinson, P., 2013. Promoting health and advancing development through improved housing in low-income settings. *J Urban Health* 90, 810–831. <https://doi.org/10.1007/s11524-012-9773-8>
- Huynh, P.T.A., Resurreccion, B.P., 2014. Women's differentiated vulnerability and adaptations to climate-related agricultural water scarcity in rural Central Vietnam. *Climate and Development* 6, 226–237. <https://doi.org/10.1080/17565529.2014.886989>
- IPCC, 2012. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (No. A Special Report of the Intergovernmental Panel on Climate Change Working Groups I and II (Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley, eds.)). Cambridge University Press, Cambridge, UK, and New York.
- Knapman, C., Sutz, P., 2015. Reconsidering approaches to women's land rights in sub-Saharan Africa (IIED Briefing). IIED, London, UK.
- Kovats, R.S., Hajat, S., 2008. Heat stress and public health: a critical review. *Annu Rev Public Health* 29, 41–55. <https://doi.org/10.1146/annurev.publhealth.29.020907.090843>
- Lehman, S., 2016. Integrating Gender Considerations into Community-based Adaptation in Agrarian Communities in the Lower Mekong Basin. USAID Mekong ARCC.
- Michon, P., Cole-Tobian, J.L., Dabod, E., Schoepflin, S., Igu, J., Susapu, M., Tarongka, N., Zimmerman, P.A., Reeder, J.C., Beeson, J.G., Schofield, L., King, C.L., Mueller, I., 2007. The risk of malarial infections and disease in Papua New Guinean children. *Am. J. Trop. Med. Hyg.* 76, 997–1008.

- Mitchell, T., Tanner, T., Lussier, K., 2007. We know what we need: South Asian women speak out on climate change adaptation. ActionAid and Institute of Development Studies, University of Sussex, Brighton, UK.
- Moser, C., Satterthwaite, D., 2008. Towards pro-poor adaptation to climate change in the urban centres of low- and middle-income countries. International Institute for Environment and Development (IIED), London.
- Nelson, G.C., et al., 2009. Climate change: Impact on agriculture and costs of adaptation. International Food Policy Research Institute, Washington, DC.
<https://doi.org/10.2499/0896295354>
- O'Brien, K., Pelling, M., Patwardhan, A., Hallegatte, S., Maskrey, A., Oki, T., Oswald-Spring, ?rsula, Wilbanks, T., Yanda, P.Z., Giupponi, C., Mimura, N., Berkhout, F., Biggs, R., Brauch, H.G., Brown, K., Folke, C., Harrington, L., Kunreuther, H., Lacambra, C., Leichenko, R., Mechler, R., Pahl-Wostl, C., Przulski, V., Satterthwaite, D., Sperling, F., Sygna, L., Tanner, T., Tschakert, P., Ulsrud, K., Vigui?, V., 2012. Toward a Sustainable and Resilient Future, in: *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. Cambridge University Press.
- Onta, N., Resurreccion, B.P., 2011. The Role of Gender and Caste in Climate Adaptation Strategies in Nepal. *Mountain Research and Development* 31, 351–356.
<https://doi.org/10.1659/MRD-JOURNAL-D-10-00085.1>
- Parker, H., Oates, N., Mason, N., Calow, R., Chadza, W., Ludi, E., 2016. Gender, agriculture and water insecurity (ODI Insights). Overseas Development Institute (ODI), London, UK.
- Pelling, M., 2011. *Adaptation to climate change: from resilience to transformation*. Routledge, London ; New York.
- Perera, F.P., 2008. Children Are Likely to Suffer Most from Our Fossil Fuel Addiction. *Environ Health Perspect* 116, 987–990. <https://doi.org/10.1289/ehp.11173>
- Pham, P., Doneys, P., Doane, D.L., 2016. Changing livelihoods, gender roles and gender hierarchies: The impact of climate, regulatory and socio-economic changes on women and men in a Co Tu community in Vietnam. *Women's Studies International Forum* 54, 48–56. <https://doi.org/10.1016/j.wsif.2015.10.001>
- Ravera, F., Martín-López, B., Pascual, U., Drucker, A., 2016. The diversity of gendered adaptation strategies to climate change of Indian farmers: A feminist intersectional approach. *Ambio* 45, 335–351. <https://doi.org/10.1007/s13280-016-0833-2>
- Ray-Bennett, N.S., 2009. The influence of caste, class and gender in surviving multiple disasters: A case study from Orissa, India. *Environmental Hazards* 8, 5–22.
<https://doi.org/10.3763/ehaz.2009.0001>
- Selvaraju, R., Subbiah, A., Baas, S., Juergens, I., 2006. Livelihood adaptation to climate variability and change in drought-prone Bangladesh: Developing institutions and options. (No. 5), *Institutions for Rural Development Series*. ADPC and FAO, Rome and Bangkok.
- Sen, A.K., 1999. *Development as Freedom*. Oxford University Press, Oxford, UK.
- Sheffield, P.E., Landrigan, P.J., 2011. Global climate change and children's health: threats and strategies for prevention. *Environ. Health Perspect.* 119, 291–298.
<https://doi.org/10.1289/ehp.1002233>
- Shrestha, R., Chawewan, N., Arunyawat, S., 2017. Adaptation to Climate Change by Rural Ethnic Communities of Northern Thailand. *Climate* 5, 57.
<https://doi.org/10.3390/cli5030057>
- Talberth, J., Reyntar, K., 2014. *Climate Change in the Lower Mekong Basin - An Analysis of Economic Values at Risk, USAID Mekong Adaptation and Resilience to Climate Change (USAID Mekong ARCC)*. World Resources Institute, Washington, D.C.
- Thomalla, F., Boyland, M., Calgaro, E., 2017. Disasters and development in Southeast Asia: Towards equitable resilience and sustainability, in: McGregor, A., Law, L., Miller, F. (Eds.), *Routledge Handbook of Southeast Asian Development*. Routledge, pp. 342–361.

- Tinoco, M., Cortobius, M., Grajales, M.D., Kjellén, M., 2014. Water Co-operation between Cultures: Partnerships with Indigenous Peoples for Sustainable Water and Sanitation Services. *Aquatic Procedia* 2, 55–62. <https://doi.org/10.1016/j.aqpro.2014.07.009>
- Tschakert, P., 2012. From impacts to embodied experiences: tracing political ecology in climate change research. *Geografisk Tidsskrift-Danish Journal of Geography* 112, 144–158. <https://doi.org/10.1080/00167223.2012.741889>
- UN, 2013. Women and agricultural water resource management (UN Chronicle No. Vol. L, No. 1).
- UNESCAP, 2015. Disasters without Borders: Regional Resilience for Sustainable Development (Asia Pacific Disaster Report 2015). United Nations Economic Commission for Asia Pacific.
- UNICEF, 2015. Unless we act now - the impact of climate change on children. UNICEF, New York.
- Watt, S., Chamberlain, J., 2011. Water, climate change, and maternal and newborn health. *Current Opinion in Environmental Sustainability, Aquatic and marine systems* 3, 491–496. <https://doi.org/10.1016/j.cosust.2011.10.008>
- Webbink, E., Smits, J., de Jong, E., 2012. Hidden Child Labor: Determinants of Housework and Family Business Work of Children in 16 Developing Countries. *World Development* 40, 631–642. <https://doi.org/10.1016/j.worlddev.2011.07.005>
- Wilkinson, E., Schipper, E.L.F., Simonet, C., Kubik, Z., 2016. Climate change, migration and the 2030 Agenda for Sustainable Development. Overseas Development Institute, London.

ANNEX

Summary of data collected in each location

Chiang Rai

Location number	Informant(s) type	No. of participants	Interview/ FGD code
Location 1 (School 1)	Interview – school teacher	1	1
	Interview – school teacher	1	2
	Interview – school teacher	1	3
	FGD – school children [G4-6]	10 [4G, 6B]	4
	FGD – school children, girls [G4-6]	4G	5
	FGD – school children, boys [G4-6]	6B	6
Location 2 (Village 1)	FGD – community CCA committee	12 [2W, 10M]	7
	Interview – young woman [27y]	1	8
	Interview – young woman [31y]	1	9
	Interview – young woman [26y]	1	10
	Interview – young woman [27y]	1	11
Location 3 (School 2, Village 2)	FGD – community CCA committee	10 [6W, 4M]	12
	FGD – young women [18-27]	6	13
	FGD – school children [G7-9]	11 [9G, 2B]	14
	Interview – school teacher	1	15
	Interview – school teacher	1	16
Location 4 (School 3, Village 3)	FGD – community CCA committee	10 [4W, 6M]	17
	FGD – young women [16-17y]	4	18
	FGD – young women [15y]	3	19
	Interview – school teacher	1	20
	FGD – school children [G4-6]	9 [6G, 3B]	21

Chiang Mai

Location	Informant(s) type	No. of participants	Interview/ FGD code
Location 5 (School 4)	Interview – school teacher	1	22
	Interview – school teacher	1	23
	FGD – school children [G5-6]	15 [8G, 7B]	24
Location 6 (School 5, Village 4)	FGD – community CCA committee	8 [2W, 6M]	25
	Interview – young woman [25y]	1	26
	Interview – young woman [30y]	1	27
	Interview – young woman [29y]	1	28
	Interview – school teacher	1	29
	Interview – school teacher	1	30
	FGD – school children [G6]	10 [5G, 5B]	31
Location 7 (Village 5)	FGD – community CCA committee	10 [2W, 8M]	32
	Interview – young woman [23y]	1	33
	Interview – young woman [21y]	1	34
	Interview – young woman [25y]	1	35
	Interview – young woman [20y]	1	36
Location 8 (Village 6)	FGD – community CCA committee	7 [5W, 2M]	37
	Interview – young woman [20y]	1	38
	Interview – young woman [25y]	1	39
	Interview – young woman [19y]	1	40
Location 9 (School 6)	Interview – school teacher	1	41
	Interview – school teacher	1	42
	FGD – school children [G4-5]	6 [3G, 3B]	43

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As an independent development and humanitarian organisation, we work alongside children, young people, our supporters and partners to tackle the root causes of the challenges facing girls and all vulnerable children.

We support children's rights from birth until they reach adulthood, and enable children to prepare for and respond to crises and adversity. We drive changes in practice and policy at local, national and global levels using our reach, experience and knowledge. For over 75 years we have been building powerful partnerships for children, and we are active in over 70 countries.