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Combating heat stress in South Asia - A Cross-CARIAA effort

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Executive summary

The risk of adverse heat effects including increased heat-related morbidity and mortality and loss of productivity has increased in the past decades and is expected to grow further in the near future because of climate change. Most knowledge on heat stress applies to urban areas and to some occupational settings such as industrial complexes. However, also in large parts of South Asia agricultural workers may be heavily exposed to heat, sometimes finding hardly any relief at home because of high indoor temperatures. The impact of heat in rural settings can still be considered a blind spot. Despite projections by climate models of a warming climate and increasing frequency of extreme heat events in the coming years, the public recognition of the magnitude of hazards remains at a minimal level.

The purpose of the CARIAA cross-consortia pilot study reported here was to address these gaps, raise awareness to the problem of heat in South Asia, and gather evidence on appropriate heat mitigating measures. The main overarching goal was to advise on effective adaptive strategies to heat in South Asia.

Two pilot studies were conducted: 1) In the Sonurli and Eklara villages (Ralegaon block of Yavatmal district, Maharashtra, India) a detailed study was initiated using technical devices to obtain experimental evidence on the thermal variations and exposure to heat in the different types of houses of the socially differentiated groups. Through interviews and focus group discussions, people's perceptions on heat stress and human health, livelihood patterns and coping mechanisms were collected. 2) In the peri-urban and rural area of Faisalabad a field survey was carried out focusing on the question as to what extent well-being/comfort level of the respondents will impact their decisions to migrate, with special attention to the role of exposure to heat. Here, a quantitative approach was applied to understand the perception of different groups with regard to living and workplace conditions. Results from both pilot studies were presented during two workshops that were organised within the framework of this project in support of awareness raising.

Results confirm that people in rural areas may be equally or even more exposed to heat stress than people in an urban setting. People in rural areas are generally exposed more to sunlight. Awareness of exposure to heat and of climate change was found to be high.

Both in India and in Pakistan members of the rural population frequently reported heat related symptoms (HRS) such as headache, fatigue and intense thirst. The number and frequency of reported symptoms seemed to positively correlate with the amount of fieldwork expected in the reporting groups and with roof type, notable tin versus RCC. According to the observations housing characteristics play a predominant role in indoor exposure to heat. Relatively simple and affordable measures may result in significant reduction of exposure to heat.

Apart from technical measures, the decision to migrate can be regarded as an adaptation option. However, the relation between such a decision and climate change or heat stress was found to be only indirect. The survey in Pakistan showed that people usually migrate to improve their level of income, reduce their vulnerabilities and improve their overall standard of living. Climate and climate change have an impact on the liveability and may in this way provide an indirect incentive to migrate. Poverty is still an important barrier to heat stress mitigation measures.

Heat stress in rural areas is an overlooked problem. The present pilot studies highlight the urgency for wider and more in-depth research to better understand heat stress and thermal comfort, ventilation and radiation, and how people in rural areas are affected by these. This in turn will help identify appropriate responses.

List of acronyms

ASSAR	- Adaptation at Scale in Semi-arid Regions
AWS	- Automated Weather Station
CARIAA	- Collaborative Adaptation Research Initiative in Africa and Asia
CASCO	- Climate Adaptation and Services COmmunity
DFID	- Department for International Development
HI-AWARE	- Himalayan Adaptation, Water and Resilience
HRS	- Heat Related Symptom
HUF	- Hindustan Unilever Foundation
IDRC	- International Development Research Centre
IMD	- India Meteorological Department (Pune, India)
IPCC	- Intergovernmental Panel on Climate Change
NGOs	- Non-Governmental Organisation
OSF	- Opportunities Synergies Fund
PRISE	- Pathways to Resilience in Semi-arid Economies
RCC	- Re-enforced Cement Concrete
SDC	- Sustainable Development Conference
SDPI	- Sustainable Development Policy Institute (Islamabad, Pakistan)
W-CReS	- WOTR Centre for Resilience Studies (Pune, India)
WEnR	- Wageningen Environmental Research (Alterra)
WOTR	- Watershed Organisation Trust (Pune, India)
WUR	- Wageningen University and Research (Wageningen, The Netherlands)

1. Background

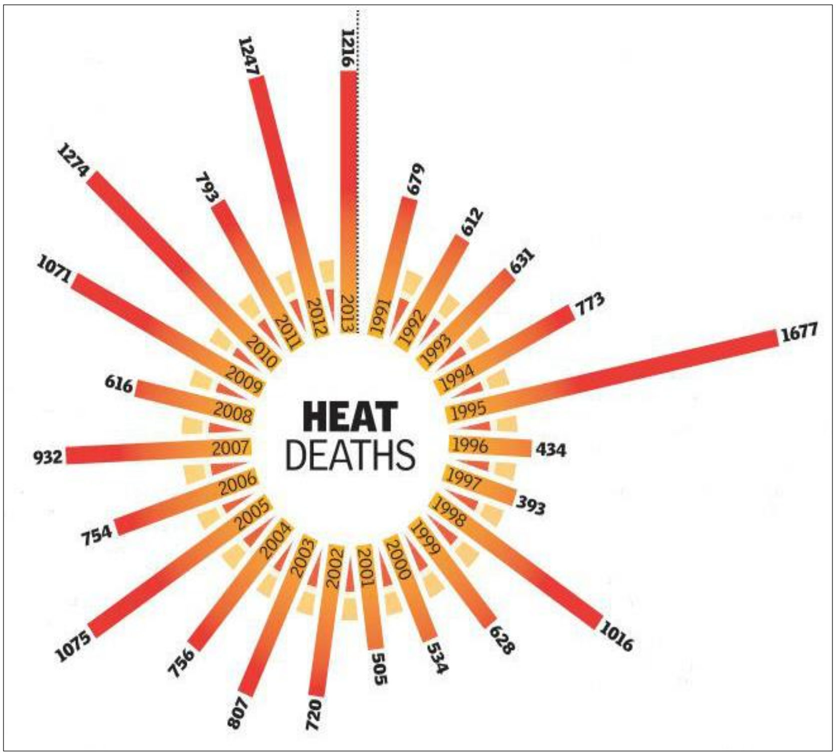
Extremely high temperatures can have strong impacts on humans, the most dramatic one being heat-related death. Such impacts occur even in regions where one would expect people being used to heat. This is underscored by the recent heat wave events in 2015 in Pakistan and India which led to approximately 4.500 casualties and by a bulletin issued by the Ministry of Earth Science in India in March 2017, according to which 4620 people in India died during heatwaves in the years 2013-2016.
(source: http://www.moes.gov.in/writereaddata/files/LS_US_3225_22032017.pdf).

The risk of adverse heat effects including increased heat-related morbidity and mortality and loss of productivity has increased in the past decades and is expected to grow further in the near future. According to the India Meteorological Department (IMD), over the past half century, from 1961 to 2010, heat waves frequencies have already increased by a third. Similarly Pakistan is facing an increasing number of heatwaves (Saeed et al. 2016). Due to climate change the frequency and intensity of heatwaves is projected to further increase over many land areas in the world, including South Asia, (IPCC, 2012).

A heat wave is usually declared based on temperature observations. For example, a heat wave in India is declared when there is an excess of 5°C over a normal daily historical maximum temperature (30 year average) of less than 40°C; or an excess of 4°C over a normal historical maximum temperature of more than 40°C. If the actual maximum temperature is above 45°C, a heat wave is declared irrespective of the normal historical maximum temperature.

Unfortunately – being purely a meteorological indicator – definitions of a heat wave do generally not reflect public health effects of extreme heat and does not take into account other factors that are important for human thermal comfort or heat stress, such as humidity, wind speed and solar radiation. Neither does it take into account whether heat persisted over longer periods affecting human health more strongly. However, people are vulnerable to heat regardless of whether a period was declared officially as a heat wave or not. This is illustrated in Figure 1, showing that in every year in the period 1991-2013 heat related deaths occurred in India.

Most literature available on heat stress (especially during heat waves) applies to urban areas, including cities in South Asia (e.g., Azhar et al. 2014, Kakkad et al. 2014, Knowlton et al. 2014, Saleem et al. 2017, Tran et al. 2013), and to some occupational settings such as industrial complexes. Cities may be warmer because of the urban heat island and on average provide less ventilation because of the influence of buildings on the wind. However, workers in agricultural areas may be exposed more to direct sunlight. Thus, farm workers are among the labour categories most exposed to heat (Kjellstrom et al. 2009). In the United States farm workers appeared to have a much larger (up to four times) probability to



experience *Figure* 1*. Heat stroke deaths in India from 1991 – 2013. Source:* *[http://www.thehindu.com/sunday-anchor/summer-of-2015-heat-wave-and-deaths/article7289830.ece.](http://www.thehindu.com/sunday-anchor/summer-of-2015-heat-wave-and-deaths/article7289830.ece)*

heat related illnesses than non-farm workers (Hansen and Donohoe 2003). However, although some recent evidence on heat stress in rural settings has become available, in particular in a socio-economic context (Ingole et al. 2017, Mueller et al. 2014), the impact of heat in rural areas can still be considered a blind spot.

Also in large parts of South Asia agricultural workers may be heavily exposed to heat – the land is barren during the hot summer months and there are very few trees to provide shade. The vast bulk of the rural population works outside doing manual labour. While agricultural activity used to be low during the hottest summer months, increased intensity of agriculture combined with changes in the timing of extreme temperatures means farmers are increasingly affected. Fatality due to heat stroke in a heat wave in 1998 among farmers was ~11% of the total reported rural casualties at workplaces (Nag et al. 2009). According to Tran et al. (2013), exposure (geographic location, housing characteristics, built environment and occupational and behavioural factors), susceptibility (age, pre-existing health status, and socioeconomic factors) and adaptive capacity (access to health services and information, coping mechanisms, infrastructure, and social capital) determine vulnerability to heat. However, there is little scientific evidence on heat experience, impact of heat exposure, and adaptation measures to heat in the rural and urban context.

Furthermore, most epidemiological studies on heat and health rely on meteorological data from standardised weather stations, which do not reflect well heat exposure for example inside houses or in areas with a different landscape present than the one where the weather stations are installed. It is unclear if the ambient daily temperature measurements from such standard stations are an under- or over-estimate of different surroundings vulnerable people are exposed to. Thus, there is a need to measure actual heat exposure of people indoors and outdoors.

Despite projections by climate models of a warming climate and increasing frequency of extreme heat events in the coming years, the public recognition of the magnitude of hazards remains at a minimal level. Administrative support systems generally lack preparedness measures, such as heat wave response plans. Most people believe that such natural phenomena and thus their consequences are unavoidable (Nag et al. 2009).

2. Goal and focus

The purpose of the CARIAA cross-consortia pilot study reported here was to address the gaps identified above, raise awareness to the problem of heat in South Asia, and gather evidence on appropriate measures. The main overarching goal was to advise on effective adaptive strategies to heat in South Asia. The study took as a starting point three different heat studies that at the time of its initiation were going on within the context of the CARIAA programme: ASSAR, HI-AWARE and PRISE.

1. *Rural exposure to heat using a field survey approach in ASSAR*
   In the ASSAR context, WOTR conducted a study that examined vulnerability under "social differentiation" from the dimension of heat stress and human health. It looked into what categories of the rural population are most vulnerable to heat stress, factors contributing to vulnerability to heat stress, existing strategies to manage heat stress and barriers/ enablers that affect the coping mechanisms for heat induced stress.

2. *Heat measurements in HI-AWARE*
   The HI-AWARE team conducted indoor and outdoor heat measurements in three urban locations in South Asia in order to determine and evaluate the contribution of meteorological conditions, housing and characteristics of the built urban environment to heat stress of urban dwellers. Preliminary measurement results from a pilot experiment Faisalabad, Pakistan, in July 2015 revealed quite large temperature variations across different houses, not only regarding daily averages but also regarding warming and cooling rates. The results suggested that such characteristics and therefore exposure to heat stress can be strongly influenced by building characteristics, without additional technical measures, suggesting that affordable heat mitigation measures at the building scale should be possible.

3. *Modelling heat waves in PRISE*

   The PRISE team, under the lead of SDPI, conducted research on Migration Futures aiming to examine the potential of migration in building economic resilience to climate change. Certain climatic trends (such as in temperature and rainfall) show non-linear, albeit strong linkages with the rural to rural and rural to urban migration in Pakistan, confirming that migration can be regarded as a climate adaption option. Results suggested that heat waves/stress may be a major climate determinant (rather than flooding, heavy rainfall or soil moisture) causing out-migration from rural areas in Pakistan. Considering the fast urbanisation rate in Pakistan (fastest in South Asia), it was argued that high rural to migration rate in Pakistan will pose a greater threat to the future development of the country when impacts of changing climate are also considered.

The research brought together the aforementioned CARIAA research approaches into heat and heat stress in South Asia, introducing the quantitative measurement approach developed for the urban HI-AWARE sites to the rural ASSAR sites in order to reveal the exposure to heat stress and the suitability of various adaptive measures in rural India in to link this to SDPI and WOTR's insights derived from participatory research aimed at better understanding of the underlying drivers and barriers behind coping mechanisms and (mal)adaptation.

These aspects and the insights so far from the ASSAR, HI-AWARE and PRISE projects led to the following research questions:

1) Which communities or groups, including gender, are more exposed to heat due to work /household demands?

2) How do the houses of the socially differentiated groups (better-off, middle class, poor and very poor) as well as the different communities differ and which are those more affected by high temperatures?

3) What are the coping mechanisms / adaptive measures adopted in high temperatures by the different categories of households?

4) Could some aspects of rural houses be suitable for urban houses to make them more heat resilient?

In the following sections we summarize the methodology and the main outcomes of the study. More details can be found in the draft policy brief (to be released in February 2018) and in the working paper which have been produced in the framework of the project and which are fully included as Annex 1 and Annex 2, respectively, to this report.

3. Methodology

In two rural to peri-urban areas, one in India and one in Pakistan, the different approaches of the three CARIAA consortia were combined to get a holistic insight into the impact of heat on rural areas.

India pilot study

In the Sonurli and Eklara villages (Ralegaon block of Yavatmal district, Maharashtra, India) a detailed study was initiated using technical devices to understand the thermal variations in the different types of houses of the socially differentiated groups as well as heat stress that come from the gender related as well as types of labour / work being undertaken by these groups. The region is well known for its high summer temperatures of 45°C and above. Heat stroke deaths and heat stress are known to occur here frequently. The changing landscape, for example large scale loss of trees and other vegetation cover and a transition from traditional mud houses to concrete houses in the area is further exacerbating exposure to heat. Of its population, 78.4 percent live in rural areas and 79.2 percent are engaged in agricultural and other outdoor manual labour. Houses in villages are earthen, or made of tin sheets or of brick with cement. Roof materials used for houses in the district are of tin, re-enforced cement concrete (RCC) and tiles (handmade or industrial). The census data (Office of the Registrar General & Census Commissioner, India, 2011) show that in the Yavatmal district as a whole, 64% of all houses have roofs made of tin sheets. Fans and more recently coolers are used to make houses more habitable during hot weather conditions.

A total of 20 temperature data loggers (18 HOBO UX100-001 loggers for temperature and 2 HOBO UX100-011 for temperature and relative humidity; Onset, USA) were applied indoors following the HI-AWARE methodology explored in Faisalabad, with the aim to assess effects of housing characteristics on indoor exposure to heat in rural environments. The loggers were installed at a height of about 1.5m, in the shade and preferably at North facing walls to avoid effects of wall heating by the sun during the day. The loggers provided valid data without significant gaps as of 10 May 2016. Collection of the measurements lasted until 31 July 2016. Data are logged as 10-minute averages from which hourly averages were computed for further analysis and comparison with outdoor temperature data. Outdoor temperature and additional meteorological variables were obtained from an Automated Weather Station (AWS) installed in the Sonurli village. These data are obtained as hourly averages.

Through interviews and focus group discussions, people's perceptions on heat stress and human health, livelihood patterns and coping mechanisms were collected. A total of 70 sample households (comprising of 326 individuals, 54% male and 46% female) were interviewed through a structured questionnaire (see Annex 3).

Pakistan pilot study

In the peri-urban/rural areas of Faisalabad, which is a common survey location for the HI-AWARE and PRISE consortia a field survey was carried out focusing on to what extent well-being/comfort level of the respondents will impact their decisions to migrate, with special attention to the role of exposure to heat. A quantitative approach was applied to understand the perception of different groups with regard to living and workplace conditions. Two study sites were compared: 1) Rural areas of Faisalabad district, and 2) Peri-urban areas of Faisalabad city. At both sites, the available economic opportunities were analysed along with the role of education and skills in the selection of a job/work. It was assessed what type of work leads to higher exposure to heat. This information was related to the reasons that induce people to migrate. Finally, the outcomes were used to assess how effective migration is to improve the economic well-being and thermal comfort level of the migrants. The questionnaires for the rural and peri-urban sites are included as Annex 4 and Annex 5, respectively.

In rural areas, non-migrant households were interviewed whereas in peri-urban areas, migrant households were interviewed. Migrant households are defined as the households who migrated from rural to the peri-urban areas within the past five years and non-migrant households are those who have been living in rural areas for the past 40 years. A total number of 80 households were randomly selected for interviews in which 40 households were selected from rural areas (non-migrant) and 40 from peri-urban areas (migrant).

In the rural areas, the age of a majority of the respondents was between 26 and 45 years. Among them, around one-third of the people are uneducated and about two-thirds have a secondary and above level of education. Agriculture is the main source of livelihood for the rural community; around three-quarters of the respondents say that they depend on agriculture for their income. Two-thirds have an income above the poverty line. On the other hand, people living in the peri-urban areas have a low level of income and only about one-third of the households interviewed have an income above the poverty line. In these areas the occupation highly depends upon the level of education and professional skills. Most of the respondents in the peri-urban areas are uneducated or have only low to middle level education. They are involved in daily wage labour activities for their livelihood. Only few people have secondary or above level of education and have a job in the public or private sector. More detailed information on the populations in the areas can be found in Annex 2.

Awareness raising activities

The goal of awareness raising was addressed by means of one workshop in India (organised by WOTR) and one in Pakistan (organized by SDPI), a policy brief (Annex 1) and a working paper (Annex 2). The workshops were conducted at the end of the project after analysis of the results. Where appropriate and feasible, workshop outcomes fed the policy brief or working paper and *vice versa*.

4. Output & outcomes

In this section, the main results of both pilot experiments will be summarized and the brief description of the workshops will be given. Further details are provided in the draft policy brief and working paper, included as the Annex 1 and Annex 2, respectively. Workshop summaries can be found in Annex 6 and Annex 7.

Main results of the India pilot study

The period between 10 May and 30 June 2016 was selected for further analyses. Figure 2 shows that this was a period with generally high temperatures. Until about 15 June, the

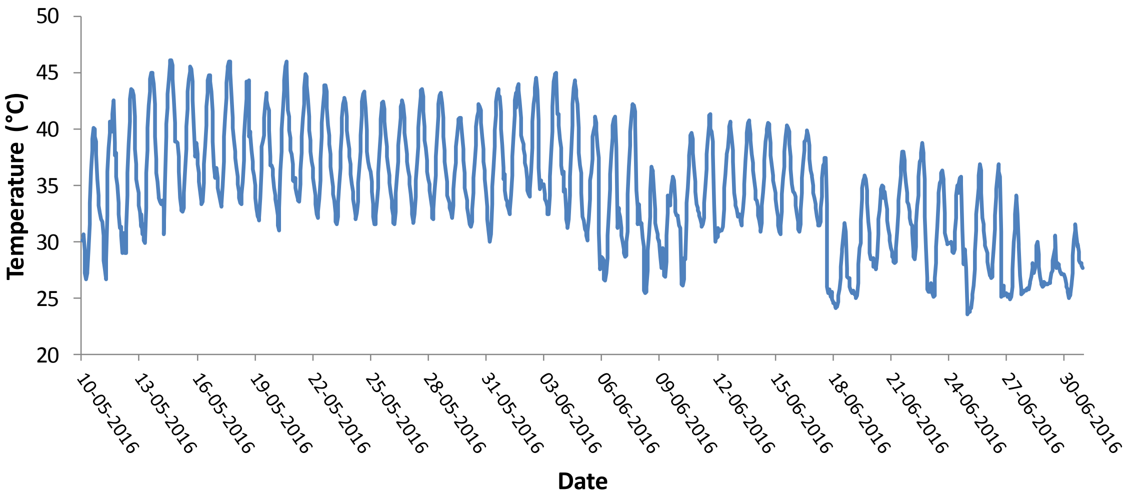


Figure 2. Observed outside temperature obtained from the AWS in Sonurli Village, India, period 10 May-30 June 2016.

maximum air temperature usually exceeded 40°C and minimum air temperatures usually remained well above 25°C. Little precipitation was observed, 18.6 mm of which 14.6 mm was collected in the last ten days of June. Daytime conditions were often quite sunny, with solar radiation levels of up to 800 Wm^{-2} and more. Clear exceptions were days with precipitation, on which the temperature also tended to be lower. Relative humidity generally ranged between about 10% and 50% until 18 June and between about 40% and 95% thereafter. Obviously, the higher values were observed during the night.

For the aforementioned period mean temperatures (minima, maxima and daily mean) as well as diurnal variations were computed for each house, house group/roof type and the outdoor temperature. The analysis revealed that the indoor temperature in houses with tin roofs is higher throughout the day as compared with RCC roof houses and even exceeds the outdoor temperature around the time the maximum temperature occurs (Figure 3, repeated from the draft policy brief in Annex 1). This does not necessarily imply that this

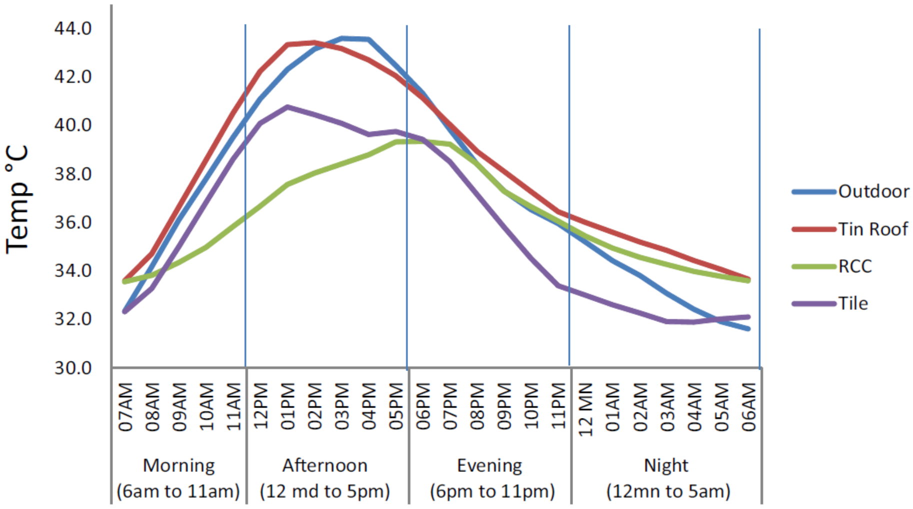


Figure 3. Mean diurnal variation of indoor air temperature of outdoor air temperature for the period 10 May – 30 June 2016.

house does not provide shelter against the heat, since people will still be protected from the sun. Unfortunately, technical failure of the devices that we originally intended to use to determine the effect of the radiation environment inside and outside houses along with ventilation (wind / air speed) and humidity levels precluded a further analyses in this regard.

Maxima under tin roofs generally seem to occur in the early afternoon, before the maximum in the outdoor air temperature. This may be indicative of a strong correlation with solar radiation, which may be expected because of the low heat capacity of the tin roofs in comparison the RCC roofs. The maximum of incoming solar radiation usually occurs well before the maximum in air temperature. In the afternoon hours the temperature under tin roofs was the hottest on average (45.8°C). In individual cases on some days temperatures of over 50°C were observed. The average behaviour of the houses with the RCC roof clearly shows the protective capacity of such houses against heat during daytime. However, while the warming rate is much less, the cooling rate is less as well, leading to night-time temperatures that are on average nearly the same as under a tin roof. Under both roof types, the night indoors was found to be warmer than outdoors. The results clearly confirm the impact of building style on exposure to indoor heat.

Now the question arises as to whether temperatures can be (further) reduced by relatively simple and affordable measures. A layer of crop residues over the tin roofs reduced the temperature by on average 4°C. Under RCC roofs the indoor temperature is substantially decreased (by 9°C) by using coolers (see Chart 3 in the draft policy brief, Annex 1). Fans do clearly not reduce the temperature, but they have a cooling effect via their ventilation. Thus, in order to provide cooling during day and night these devices have to be on all the time. However, this could not be verified or quantified with measurements for the reason given above. All in all it can be concluded that (combinations of) simple measures can already lead to a significant reduction of exposure to heat.

Results from the interviews (see Figure 4, copied from the draft policy brief in Annex 1) confirmed the impact of tin versus RCC roofs on exposure to heat. Of the 326 individuals interviewed, 152 (47%) individuals reported at least one heat related symptom (HRS); 67% of these people resided in tin roof houses. The main HRS symptoms reported during the summer of 2016 in the study sample are: heavy sweating, leg cramps, intense thirst, fatigue and disorientation (see Chart 6 in the policy brief, Annex 1). A higher percentage of men (57%) reported HRS as compared to women (42%). Among age groups, the 19-45 years group (Chart 5) reported more HRS. These differences can probably be explained by the fact that spend long hours in outdoor livelihood activities exposing them to high temperatures and notably direct sunlight.

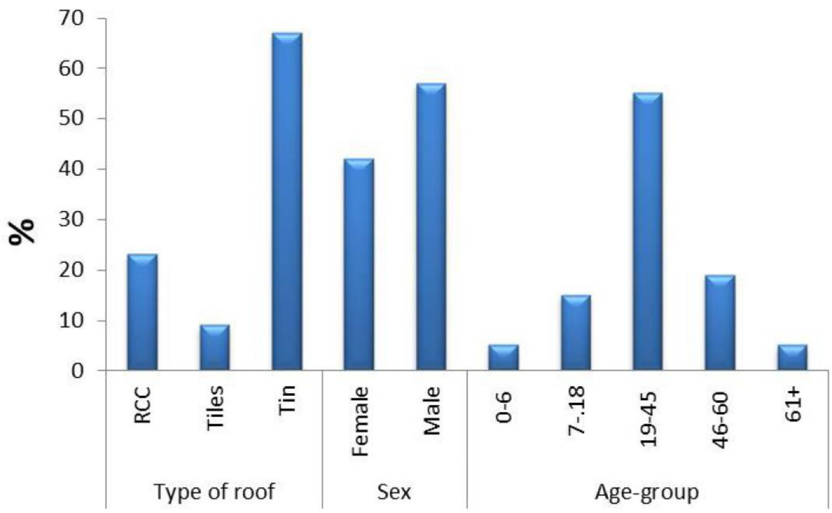


Figure 4. Fraction (%) of individuals reporting Heat Related Symptom (HRS).

Main results of the Pakistan pilot study

In the rural community around Faisalabad almost all the farmers reported that they work under direct sunlight or a place of excessive exposure to heat during the summer (See Figure 4 in the working paper, Annex 2) and around 98% of the rural workers felt that their type of work leads to enhanced exposure to heat. Almost all of the rural workers think that their productivity decreases in summer because of exposure to heat. In rural areas, there is no proper system available to prevent them from heat stress during work. However, people usually cover their head with a piece of cloth and use shade as a shelter from the heat. Furthermore, they drink cold water and use intensive bathing to prevent heat stress. It is felt that the heat exposure and lack of preventive measures during working time may lead to health impacts. Of the respondents from the rural community, 97.5% believe that heat can damage their health and HRS are commonly reported. The most common symptoms of the heat stress are intense thirst, headache, low blood pressure and dark urine. In total 46% of the respondents claimed that they feel at least one of the symptoms twice a month. Respondents who live in rural areas have their own houses comprising more than two rooms. Around 75% of the houses are made of brick walls and t-iron roofs covered with a layer of soil. In 85% of the rural houses, windows have been kept for better ventilation. A majority of the respondents use fans for cooling at home; only 2.3% and 4.7% use air conditioner or air cooler respectively. In total 58% of the respondents feel that the available heat mitigating equipment is usually sufficient to fulfil their needs. However, on the days with excessive heat, a majority of the respondents face problems like reduction in sleep quality and time and heavy sweating during night-time.

Of the respondents in the peri-urban community around 89% of daily wagers and 80% of the business/transport/construction workers in the group of respondents say that their type of work requires excessive exposure to heat. Preventive measures such as shade, cooling equipment like fans and air-conditioners, and other safety measures (like a cap, hat, of piece of cloth to cover head) are partly provided by the employers (40%), which is a clear difference with the situation in rural areas. In spite of such availability of very basic cooling facilities nearly 40% of the respondents feel tiresome during work and about 55% think it is difficult to work. Drinking large amount of cold water or other local or traditional beverages is the most common strategy among the part of the peri-urban population that either doesn't have the access to other cooling facilities or cannot afford those economically. The housing situations in this environment does not necessarily provide relief from heat. Of the respondents, nearly 63% lives in the rented houses. These houses generally have rooms with limited ventilation facilities with fans being the only cooling equipment available. Although around 60% of the respondents think that a fan along with continuous supply of electricity is sufficient for them to survive the heat people still feel discomfort during times of excessive heat in their small houses having less ventilation facilities as compared to houses in rural areas. The people of the peri-urban community are also concerned about the impact of heat stress on health (92.5%). The most common symptoms of heat stress reported in this community are headache, dark urine, intense thirst and heavy sweating. One third of the respondents feel at least one of these symptoms twice a month and at least 95% of the affected people visit a hospital or a clinic if such symptoms occur.

In both communities there is quite some awareness of climate change (over 90% of the respondents). Among the most reported features perceived by the respondents is an increase of temperature and humidity, apart from a decrease in rainfall. As a result, nearly 54% of the rural community considers heat stress to be an important factor affecting their livelihood as compared to 44% in the peri-urban area. While no significant direct relation between climate change and the decision of migration was reported, an indirect relation can be established (see Figure 5, copied from the working paper in Annex 2). Owing to the impact on livelihood 82.5% of migrants in the peri-urban setting think their economic activities were affected by climate change at their previous locations. Search for better livelihood opportunities and dissatisfaction with the living standard were important factors in the decision of migration. A direct relationship with exposure to heat was among the less important reasons for migration.

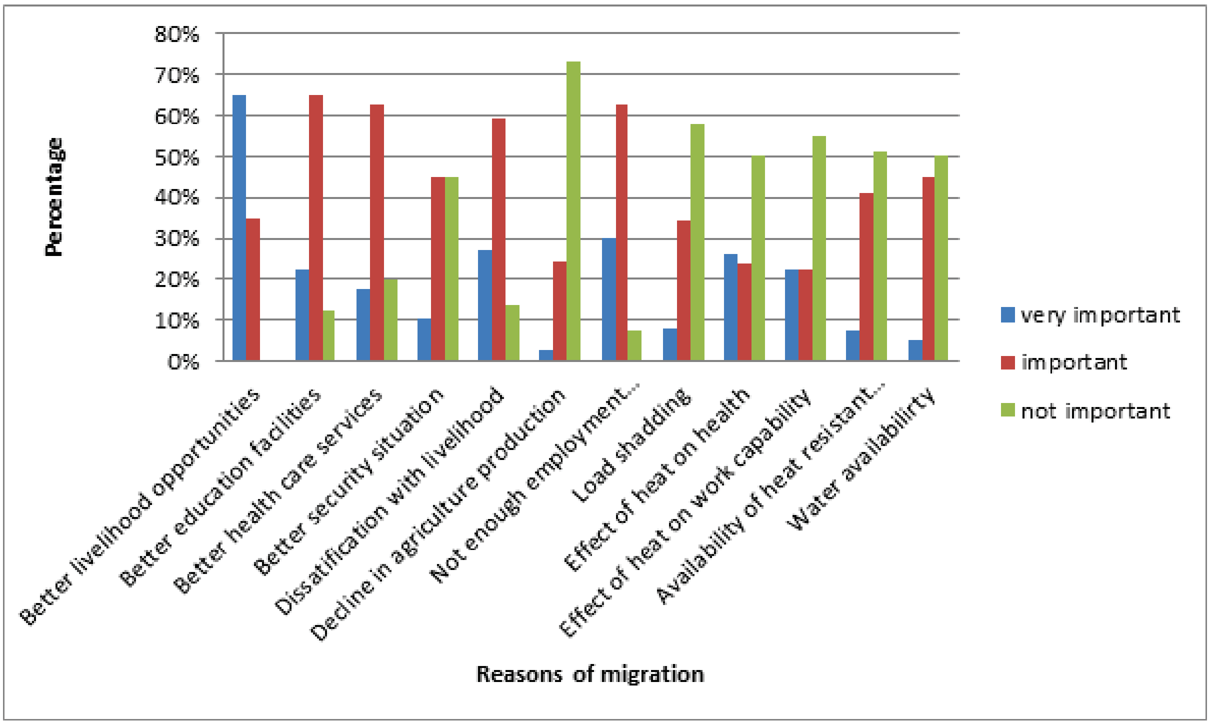


Figure 6. Importance of reasons for migration decisions (peri-urban).

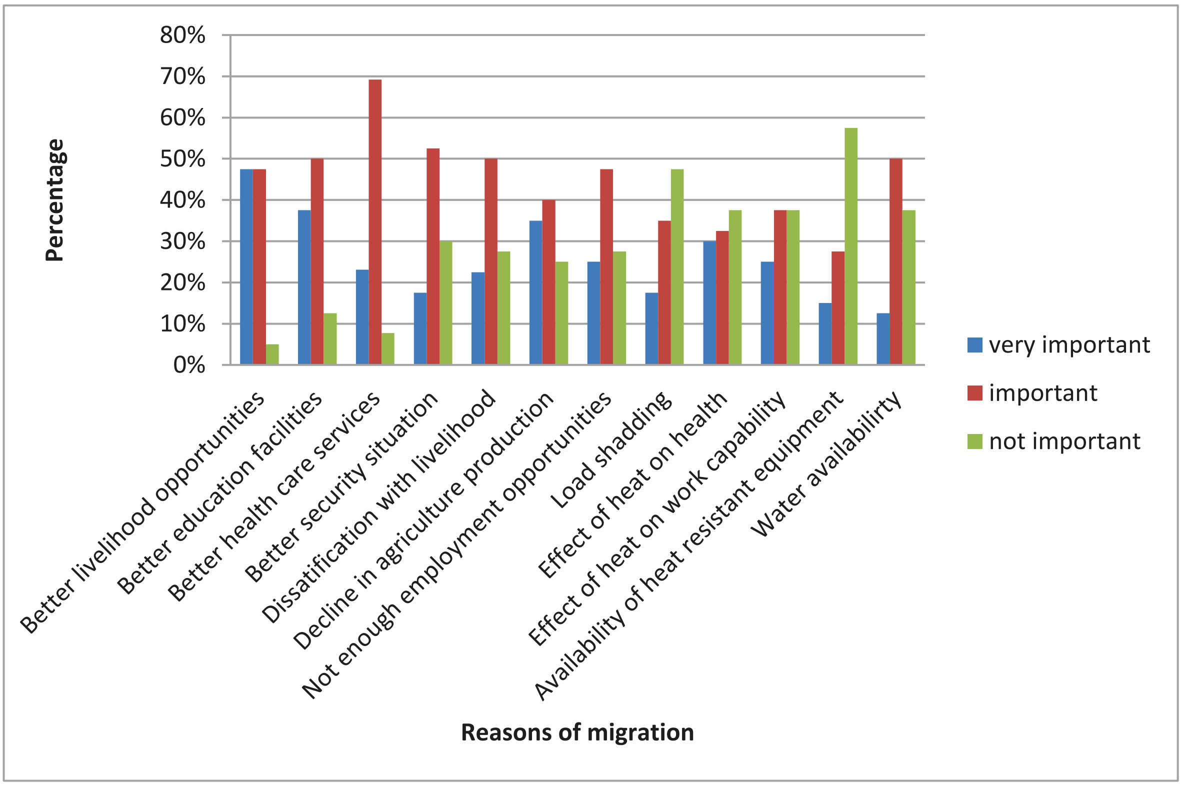


Figure 5. Importance of reasons for possible future migration decisions (rural).

In the rural (non-migrant) community 95% of the people are willing to relocate out of which nearly 80% want to move to cities and 15% want to move to any other village. Reasons are a better livelihood, education and health facilities. The role of climatic factors in migration decisions is relatively small, but gaining importance interest, mainly because of the decline in agriculture production. The impact of heat stress on the workability of the people is also increasing in importance migration decisions (see Figure 6, copied from the working paper, Annex 2). However, like in the peri-urban community the direct relationship with factors related to heat exposure is still among the least important ones.

Workshops

In the framework of the project two successful workshops were organized:

- **Consultation on Climate Adaptation and Services for Water, Food and Health Security**
  The Watershed Organisation Trust (WOTR) through its newly established Centre for Resilience Studies (W-CReS) in collaboration with Wageningen University and Research (WUR) and with support from the European Commission, Canada's International Development Research Centre (IDRC), the UK Department for International Development (DFID) & the Hindustan Unilever Foundation (HUF), hosted a Consultation workshop on the 20-21st of April 2017 in Pune, (Maharashtra) India. The goal was to assess existing synergies and disconnects between climate adaptation and services and enabling the formation of linkages between researchers and stakeholders. The event, over a period of two days, focused on question of climate change adaptation and climate services in the context of water, food and health security. Researchers from India and Europe interacted with stakeholders from the government agencies, NGOs, the private sector and innovative small and medium enterprises in order to facilitate an exchange of knowledge and to develop new partnerships. See workshop summary in Annex 6.

- **Migration, water management and climate change in glacial river basin and semi-arid regions in Pakistan: Key linkages and policy options**
  This workshop was organized by SDPI and PARC, under the umbrella of the Twentieth Sustainable Development Conference (SDC), SDPI's most important event which attracts policy makers and media hosts many international participants. This conference was held December 5-7, 2017, in Islamabad, Pakistan. Topics discussed during the workshop included heat stress conditions and their impact on migration decision; the potential of migration as an adaptation strategy in semi-arid regions and Indus river basins in Pakistan; dynamics of water governance including challenges, less focused aspect of water economy, climate change scenarios, food energy and water nexus and the way forward to sustainability; human security in relation to water, climate change and policy management; historical floods experienced in Pakistan and flood management. See workshop summary in Annex 7.

5. Conclusions

Results from this study show that people in rural areas may be equally or even more exposed to heat stress than people in an urban situation, in spite of the generally higher urban (night-time) temperatures. Both in India and in Pakistan members of the rural population frequently reported heat related symptoms (HRS) such as headache, fatigue and intense thirst. The number and frequency of reported symptoms seemed to positively correlate with the amount of fieldwork expected in the reporting groups.

The main reason is that agricultural workers are much exposed to direct sunlight. Notably the results in Pakistan showed that people are well aware of their exposure to heat, including sunlight. Fortunately, they are also aware of simple preventive measures like staying in the shade, using cooling equipment like fans and air-conditioners, and other safety measures (like a cap, hat, of piece of cloth to cover head) and drinking large amounts of water or other beverages. An important difference between rural and (peri-)urban settings is, that such measures may be made available by employers in the urban setting, while this is not the case in the rural situation. This may also contribute to enhanced exposure of members of the rural population.

Poverty enhances vulnerability to heat stress in rural as well as peri-urban areas. It forces people to work even in a hot environment, without any break, in order to earn a liveable income. It may not always be possible to find relief from heat at home in rural areas. The amount of relief from heat was found to depend on the building style. In India, some differences could be objectively quantified. Notably in houses with tin roofs the temperature may become higher than the outdoor temperature, because they heat up very quickly, probably partly due to the direct influence of the sun. The latter may be a difference with the urban setting, where mutual shading of houses is likely to be more structural and at least prevents (parts of) walls to be heated up strongly. Houses with RCC roofs give much more protection during daytime, but also cool down slower and may be as warm as houses with tin roofs during the night.

Application of simple measures against exposure to heat and development of heat stress are sometimes possible, like a layer of crop residues on tin roofs that seems to effectively shade the roof, thereby preventing excessive daytime temperatures. Sometimes, simple coolers can be applied, but if this leads to more humid air this is not necessarily improving the thermal comfort situation. Fans do not lower the air temperature as such, but because of the enhanced air flow ventilation and therefore thermal comfort can still be improved.

Other housing aspects may be important as well. Respondents of the rural community in Pakistan reported that they felt to be able to deal with indoor heat in general, with the exception of extremely hot situations. Urban dwellers tended to be somewhat less happy with the situation at home. The reason for this difference may be that –at least in Pakistan-the houses in rural are generally somewhat more spacy (more and/or bigger rooms) and allow better ventilation because there tend to be more windows.

In particular during daytime, higher air temperatures indoor than outdoor do not necessarily imply higher exposure to heat in terms of thermal comfort, because of the protection from the sun when staying indoor. On the other hand, humidity levels may be higher and ventilation (wind speed) may be less inside a house. The fact that people living in houses with tin roofs reported heat related symptoms clearly more often than respondents living in other, more protective houses, underscores the fact that the housing situation is important with regard to exposure and provision of relief from heat. To objectively assess and quantify exposure of rural workers to heat their exposure to air temperature, humidity, (solar) radiation and wind (ventilation) should be followed during the course of the day and during the night in their working environment and at home. Unfortunately, such an integral exposure could not be quantified in this study because of unforeseen technical issues with the instrument that was intended to be used for this purpose. It is recommended to attempt systematic exposure studies in future research.

Heat stress in rural areas is an overlooked problem. The OSF pilot study highlights the urgency for wider and more in-depth research to better understand heat stress and thermal comfort, ventilation and radiation, and how people in rural areas are affected by these. This in turn will help identify appropriate responses.

Apart from technical measures, the decision to migrate can be regarded as an adaptation option. However, this relation was found to be indirect. The survey in Pakistan showed that people usually migrate to improve their level of income, reduce their vulnerabilities and improve their overall standard of living. Climate and climate change have an impact on the liveability and may in this way provide an indirect incentive to migrate. In Pakistan the respondents to the survey appeared to be well aware of climate change. At both pilot study sites the people seem to be well aware of potential heat stress problems. However, although consideration of heat stress seems to become more important in a decision to migrate, a direct relation between exposure and heat stress could not be established. Improvement of income may ultimately also improve thermal comfort levels, since level of income and type of work are associated with the availability of heat resistant equipment. Poverty is still an important barrier to heat stress mitigation measures. This underscores the need for affordable adaption measures in rural as well as urban settings.

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Annex 1: Draft policy brief

(WOTR-WUR, Initial MS Word version; version in final layout will be released by WOTR in February 2018)

Vulnerability to Heat Stress:

A Case Study of Yavatmal, Maharashtra, India

Policy Brief No.5 February 2018

Premsagar Tasgaonkar, Marcella D'Souza, Ramkumar Bendapudi and Cor Jacobs

Key Messages

- Over the past half century heat wave frequencies in India have increased by a third and the risk of morbidity and mortality related to heat stress is increasing.
- Housing material particularly of roofs and cooling devices, play an important role in regulating indoor temperature.
- Post noon in the peak of summer, people in the rural agrarian Vidarbha region are exposed to high temperatures both outdoors, as well as indoors.
- For reducing heat stress, preventive action is essential. Coordination within government institutions such as Departments of Rural Development, of Health and Agriculture and the National Disaster Management Authority (NDMA) need to be brought into the discussion.

Context and Focus

In India, heat wave conditions are generally experienced in the summer months of April and May and from time to time deaths due to heat waves have been reported from several parts of the country. Between 2001 and 2012[1], heat stroke accounted for 4% of all deaths from natural calamities (Chart 1), with a marked rise seen in recent years. According to the India Meteorological Department (IMD), over the past half century (1961 to 2010) heat wave[2] frequencies have increased by a third[3]. With the rise in average global temperature, a further increase in the number of hot days and greater frequency and severity of heat-waves is expected. The risk of morbidity and mortality related to heat stress will continue to increase. Hence, effects of heat stress on human health are becoming an issue of growing concern in India.

[1] Compiled from State-wise distribution of accidental deaths by natural causes from https://data.gov.in/catalog/stateut-wise-distributionaccidental-deaths-natural-causes

[2] A heat wave in India is declared when there is an excess of 5°Celsius over a normal daily historical maximum temperature (30 year average) of less than 40°Celsius; or an excess of 4°Cover a normal historical maximum temperature of more than 40°C. If the actual maximum temperature is above 45°C, a heat wave is declared irrespective of the normal historical maximum temperature.

[3] http://raghu.umd.edu/pressmentions/Heat-Waves-India.pdf

Environmental factors that define exposure to heat, human thermal comfort and heat stress are air temperature, airflow (wind speed), humidity and radiation. In an indoor environment, these factors are influenced by building style, characterized by type and construction of the roof and walls and the application of cooling devices such as fans and water coolers. Besides these, the nature of work, physical activities and behaviour of individual play a role. Sensitivity to heat is related to personal factors such as age and general health conditions, combined with the body's ability to respond to heat, which defines the vulnerability.

Most epidemiological studies on heat and health rely on meteorological data from standardized weather stations that do not adequately reflect exposure to heat, for example inside houses and landscape characteristics of a location (other than the type where the weather stations are installed). It is unclear if the measurements from such stations are an under or overestimation of the temperature of the various surroundings that vulnerable people are exposed to.

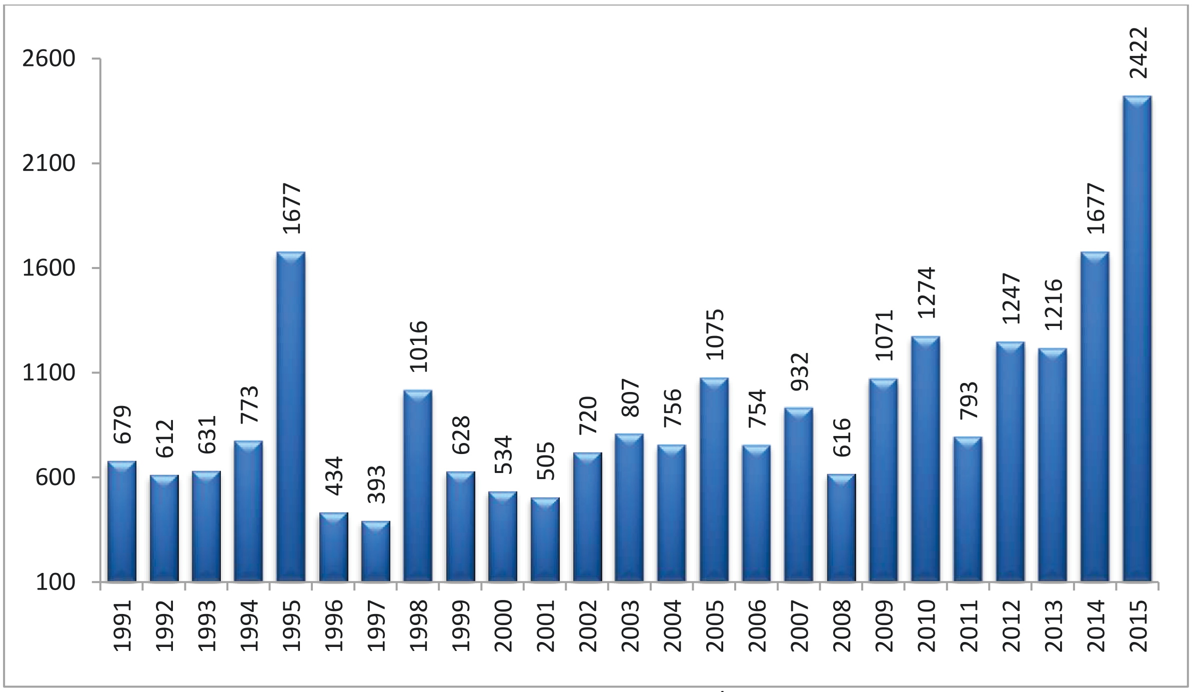


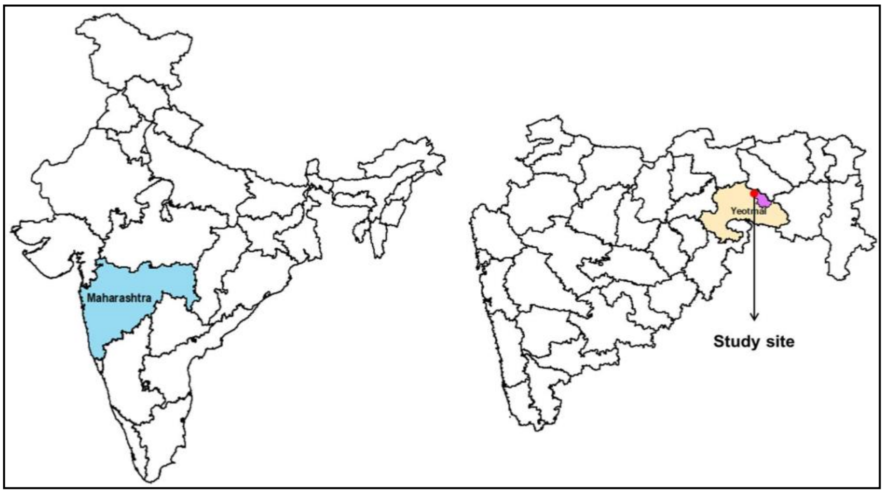
Chart 1: Reported heat stroke deaths in India from 1991 – 2015[4].

The impact of heat in rural areas has been a blind spot so far. While in earlier years agricultural activity was low during the hottest summer months, today, the increased intensity of agriculture combined with changes in timings of working hours (i.e. working during the hottest time of the day) means that farmers and outdoor labourers are increasingly exposed to heat. This study provides a pilot assessment of vulnerability to heat exposure in a rural context during the peak summer months of 2016 with a focus on indoor and outdoor temperatures.

[4]Compiled from State-wise distribution of accidental deaths by natural causes from https://data.gov.in/catalog/stateut-wise-distributionaccidental-deaths-natural-causes (The mentioned figures are recorded in National Crime Records Bureau (NCRB) and Open Government Data (OGD) Platform India)

Study area:

The study is located in Sonurli and Eklara villages (Map 1) in Yavatmal district, Maharashtra.



Map 1 The study location: Sonurli and Ekalara villages, Ralegaon block, Yavatmal district, Maharashtra

Yavatmal district in the Vidarbha region in eastern Maharashtra, experiences high summer temperatures up to a 45°Celsius in the peak of summer. Of its population, 78.4 percent live in rural areas and 79.2 percent are engaged in agricultural and other outdoor manual labour. Houses in villages are earthen, or made of tin sheets or of brick with cement. Roof materials used for houses in the district are of tin, re-enforced cement concrete (RCC) and tiles (handmade or industrial). Census data[5] (2011) shows that in Yavatmal district as a whole, 64% of all houses have roofs made of tin sheets. Fans and more recently coolers are used to make houses more habitable during hot weather conditions.

Methodology:

Outdoor temperature was measured by an Automated Weather Station (AWS) installed in Sonurli village (Photo 1). Indoor temperature was measured using 20 data loggers[6] that recorded air temperature at fixed intervals of 10 minutes. Household selection for installing data loggers was based on roof type. The roof structures found in the study location are tin sheets (67%, Photo 3), RCC (23%), and tiles (10%). The temperature loggers (Photo 2) were installed in rooms where most of the household members spent most of their time when indoors.

[5] All figure are taken from census 2011 from http://www.censusindia.gov.in/2011census/Hlo-series/HH2A.html

[6] 18 HOBO UX100-001 for temperature and 2 HOBO UX100-011 for temperature and relative humidity (Onset, USA).

Photo 1 Automated Weather Station (AWS) (Source WOTR)
Photo 2: Indoor Data Logger (Source WOTR)

Photo 3: Tin roof houses in rural Maharashtra (Source WOTR)

Through interviews and focus group discussions, people's perceptions on heat stress and human health, livelihood patterns and coping mechanisms were collected. A total of 70 sample households (comprising of 326 individuals - 54% male and 46% female) were interviewed through a structured questionnaire.

Key Findings:

The indoor temperature in houses with tin roofs is higher throughout the day as compared with RCC roof houses; it even exceeds the outdoor temperature (Chart 2).

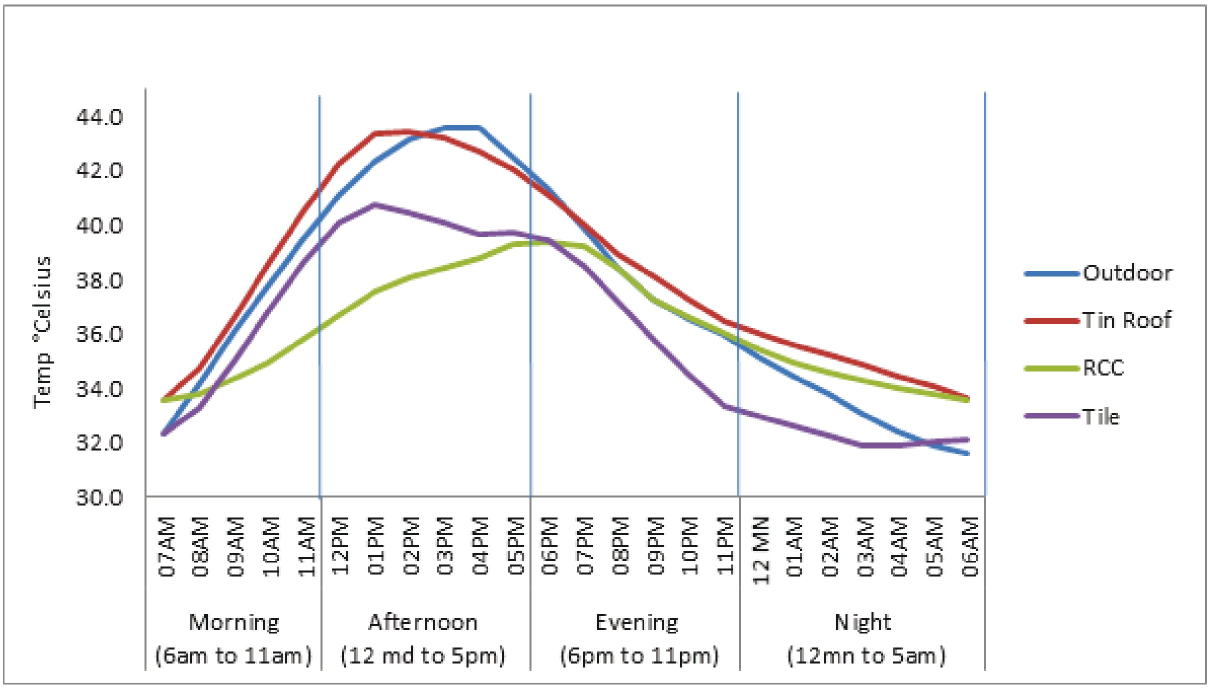


Chart 2: Average diurnal temperature of the outdoor temperature and houses with different roof material

With the outdoor average temperature reading of 42.5°C, the temperature under tin roofs was the hottest (average 45.8°C) between 12md and 6pm. A layer of crop residues over the tin roofs reduced the temperature by 4°C. Under RCC roofs the indoor temperature is substantially decreased (by 9 °C) by using coolers (Chart 3). Under both roof types, the night indoors was found to be warmer as compared to outdoors.

Maximum under tin roofs generally seem to occur in the early afternoon, before the maximum in the outdoor air temperature. This may be indicative of a strong correlation with solar radiation, which may be expected because of the low heat capacity of the tin roofs in comparison to RCC roofs. The maximum of incoming solar radiation usually occurs well before the maximum in air temperature.

During the hottest period of the day in summer, i.e., between 11am and 5pm, when people are generally indoors, it was found that for a duration of 10 consecutive days, the outdoor readings ranged from 42°C to 45°C, while within the tin roof houses people were exposed to temperatures ranging from 45°C to 48°C, which was even higher than the outdoor temperature.

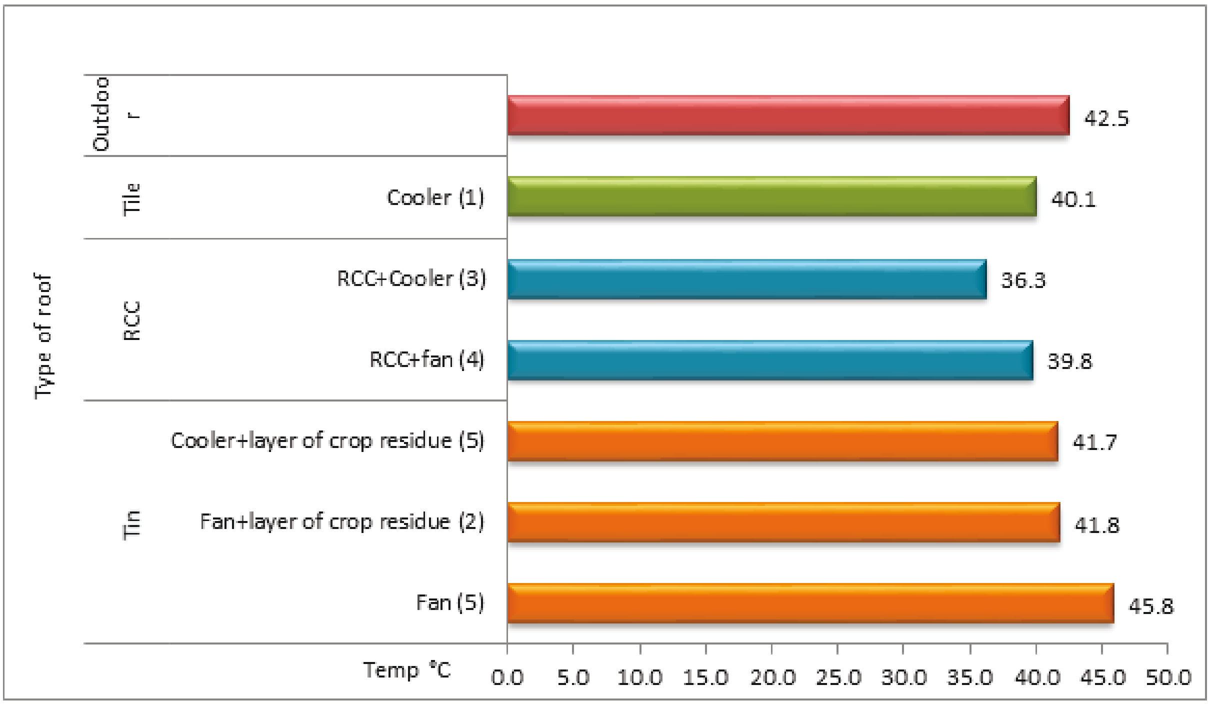


Chart 3: Average air temperature measured outdoors and indoors under different roofs (20 data loggers)

Chart 4 shows the average diurnal variation of indoor temperature in the 20 houses. The indoor temperature between 12 hrs to 16 hrs inside tin roof houses recorded up to 49°C. The temperature peaked in the afternoon in all house types. In general, indoor room temperature was highest between 12 hrs to 16 hrs in all types of roofs.

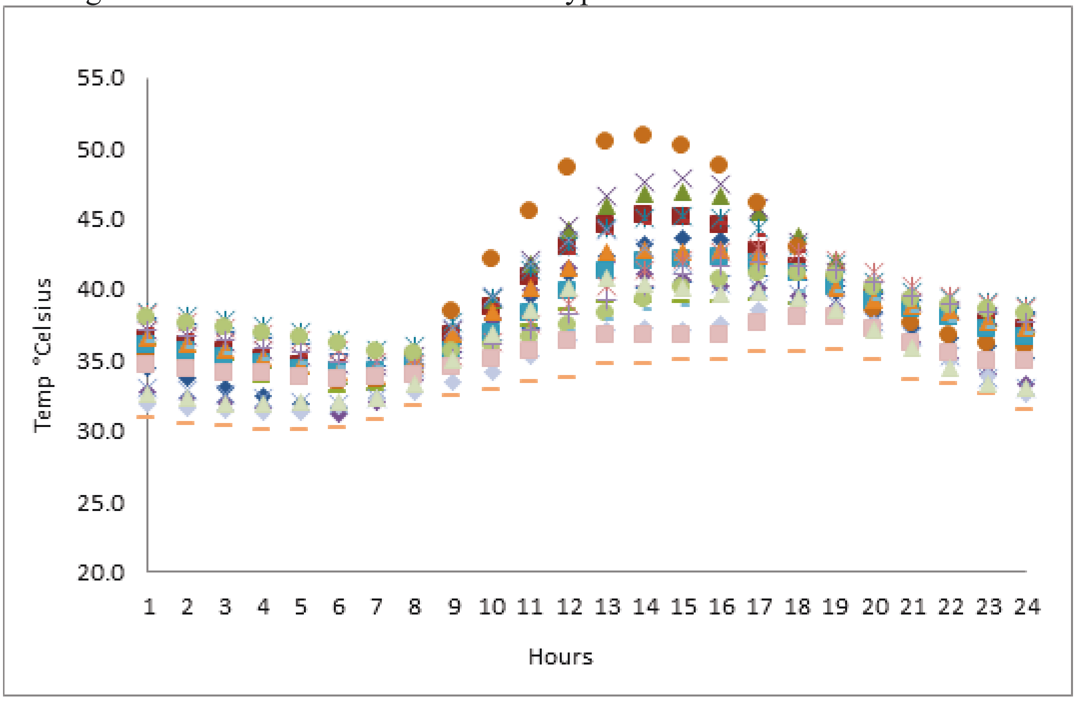


Chart 4 Diurnal variation of temperature within the different roof types.

Of the 326 individuals interviewed, 152 (47%) individuals reported at least one heat related symptom (HRS); 67% of these were people who resided in tin roof houses. A higher percentage of men (57%) reported HRS as compared to women (42%). Among age groups, the 19-45 years group (Chart 5) reported more HRS as they spend long hours in outdoor livelihood activities exposing them to high temperatures and direct sun-light.

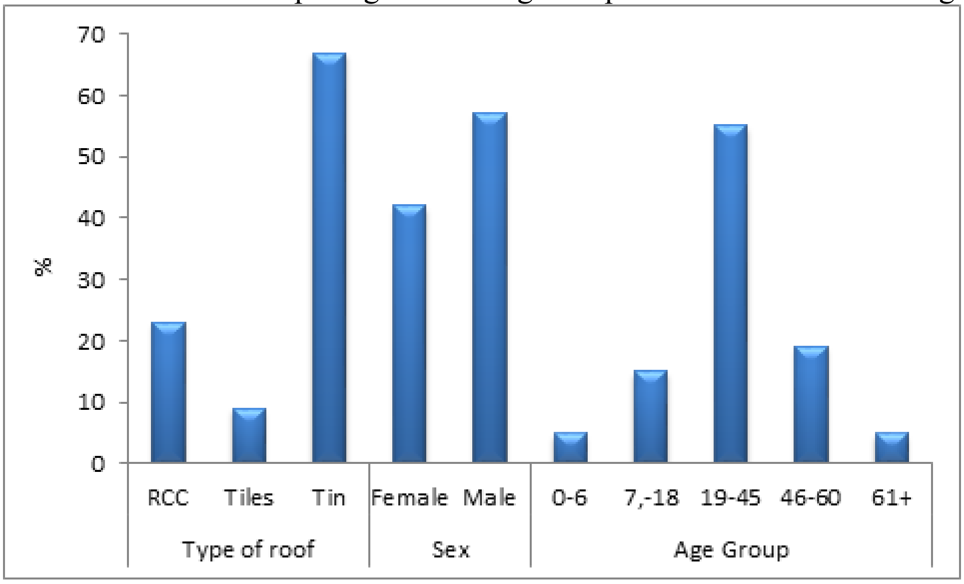


Chart 5 Percent of individuals reporting Heat Related Symptom (HRS)

The main HRS reported during the summer of 2016 in the study sample are: heavy sweating, leg cramps, intense thirst, fatigue and disorientation (Chart 6).

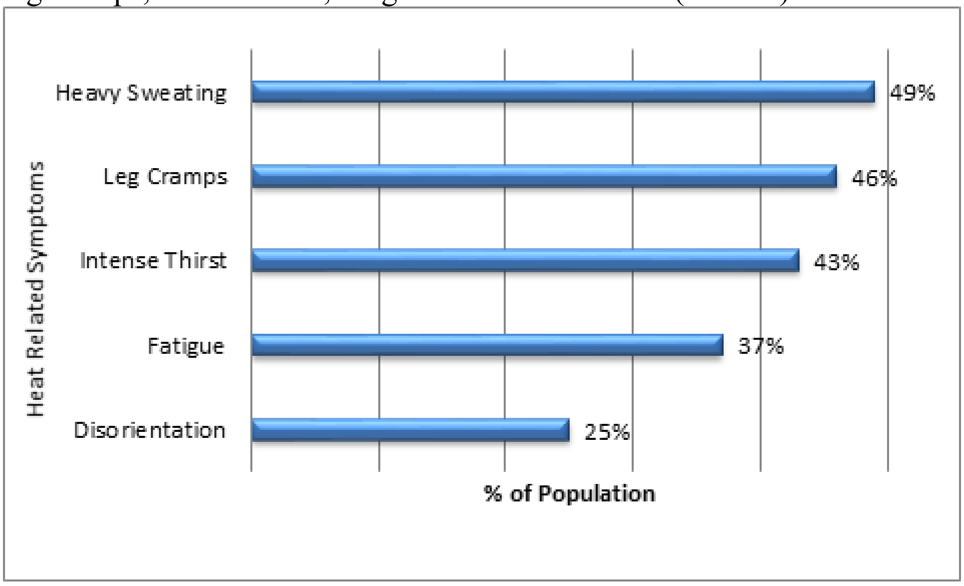


Chart 6: Major Heat Related Symptoms (HRS) reported during the summer of 2016 in the study sample

Conclusions and Recommendations:

The findings of this pilot study show that a large rural population is exposed to heat stress both outdoors and indoors. Besides working men, the other people affected by heat stress are: the ill, the elderly and women particularly when cooking (using firewood based cooking stoves), fetching drinking water and collecting firewood.

Tin roofs contribute most to indoor heat stress during peak summer months. Heat related symptoms need to be identified early and precautionary measures taken in order to avoid extreme heat stress.

Urgent measures are required to reduce exposure to heat stress: e.g. promotion of crop residue layers on tin roofs; constructing community halls with good ventilation and RCC roofs to provide space to rest during the hottest hours of summer months. The use of coolers greatly reduces indoor temperature, but the availability of water and electricity, as well as funds to purchase them are required. Heat stress may be reduced by improving housing design, adjusting work hours in summer e.g. in the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) and providing drinking water for labourers during work hours.

Heat stress in rural areas is an overlooked problem. This pilot study highlights the urgency for wider and more indepth studies to better understand heat stress and thermal comfort, ventilation and radiation, and how rural areas are affected by these. This in turn will help identify appropriate responses. While addressing heat stress related symptoms is essential and rests with the health department, its prevention will reduce morbidity and mortality. However its prevention falls in the domain of other government department e.g. rural development. Findings from such studies will call for government institutions and departments to work together towards this end.

Villagers and cattle taking shelter under a tree during hot summer days (Source WOTR)

About Watershed Organisation Trust (WOTR) & the WOTR Centre for Resilience Studies (W-CReS)

WOTR is a not-for-profit organization founded in 1993 operating currently in 8 Indian states: Maharashtra, Telangana, Seemaandhra, Madhya Pradesh, Rajasthan, Jharkhand, Bihar and Odisha. WOTR is recognized widely as a premier institution in the field of participatory Watershed Development and Climate Change Adaptation. Its unique strength lies in its on-field experience and in a systemic, participatory approach. The W-CReS is the applied research unit of WOTR that focuses on trans-disciplinary research.

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The policy brief is an outcome of a pilot research project "Combating Heat Stress in South Asia" conducted in the Vidarbha region of Maharashtra (India). The pilot study was implemented in collaboration with the Wageningen Environmental Research (Alterra) Team Climate Change WUR, Netherlands, under the Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA), supported by the International Development Research Centre (IDRC) and the Department for International Development (DfID). The WOTR Centre for Resilience Studies (W-CReS) carried out the research titled "Heat Stress and Human Health, in Vidarbha, Maharashtra" to understand the impact of heat stress on human health.

Annex 2: Working paper on the Role of heat stress in migration decision: a case study of Faisalabad (SDPI)

Muhammad Awais Umar and Dr Fahad Saeed

Executive Summary

Heat affects individuals' attitude, health and performance. If heat exposure exceeds certain threshold levels, this may result in discomfort, heat stress and other heat-related illnesses or even death. People, who work under direct sunlight (agriculture work) or place of excessive heat (industrial work) are more vulnerable to heat stress. Lack of safety protocols, cooling facilities and heavy pace of work increases the risk of heat stress for farm as well as non-farm workers. In many developing countries, workers face decline in productivity due to their hot working environment.

Migration could be an adaptation strategy to reduce the impact of climate change, including heat stress. It provides the opportunity to reduce risk and diversify livelihoods. Extreme heat stress is found to be more associated with migration because it affects the livelihood by reducing the farm and non-farm income and then may drive out-migration. However, a direct link between heat stress and migration decisions has not been established so far.

This study is an attempt to understand the relation between migration decisions and heat stress, not only its impact on livelihoods but also on thermal comfort level at home as well as at workplace. It takes into consideration how does heat stress affect the workability of the workers, what type of work is more exposed to heat stress, how is the level of income associated with discomfort at work and at home and to what extent these stressors play a role in decision of migration and the choice of new destination.

For this purpose, a household survey was conducted by using a structured questionnaire to compare two study sites 1) Rural areas of Faisalabad district 2) Peri-urban areas of Faisalabad city. A total number of 80 households were randomly selected for interviews, 40 from each site. At both sites, the available economic opportunities were analyzed to establish the reason that induces people to migrate. Along with this it was assessed what type of work is exposed most to heat and finally, how effective migration can improve the economic well-being and thermal comfort level of the migrants.

The study finds that people of both sites are well aware of heat stress; In addition to electronic media, self-assessment is the most common source of information. People involved in outdoor activities (farming and daily wage labour) feel that they are exposed to heat stress at their workplace. Lack of sufficient safety measures and improper preventive tools further contribute to their vulnerabilities. Level of income is also found to be associated with occupational and non-occupational vulnerabilities to heat stress; low income is the prime barrier to adaptation to heat stress.

Our findings show that people usually migrate to improve their level of income, reduce their vulnerabilities and improve their overall standard of living, but due to low level of education and skills, they have only been able to improve their livelihoods to a limited extent.

The study concludes that migration is reducing livelihood vulnerabilities by providing more economic opportunities to the migrants, but its relation with the improvement of thermal comfort and heat exposure is very weak. Improvement in thermal comfort level is associated with the availability of heat resistant equipment, which highly depends on the level of income, and type of work.

1 Introduction

Heat affects individual's attitude, performance, and overall health (Zahid and Rasul 2010). Apart from temperature, radiation, wind speed, and air humidity also contribute to heat stress (Stathopoulos 2009). If exposure to heat exceeds certain threshold levels, this may result in discomfort, heat stress and other heat-related illnesses or even death (Smith et al. 2014). It has been evident that workers who work under direct sunlight or physical work are more vulnerable to heat stress (Kjellstorm 2009; Lin and Chang 2009). Workers in many developing countries face a decline in output/productivity due to their hot working environment (Kjellstorm et al. 2016).

It is projected that due to climate change, the number of hot days and length of heatwave periods will increase over most land areas like Europe, Africa, Asia, America, etc. (IPCC 2012; Stapleton et al. 2016). As a result, the prevalence of heat stress related illness will also tend to rise (Heal et al. 2003). Workers across the world will be increasingly exposed to heat in particular, if proper counter measures are not taken.

Pakistan is an agricultural country with around 42 per cent of the population depending on agriculture sector (Economic Survey 2016-17). The role of industrial sector is also important in terms of its contribution to GDP and provision of employment opportunities to the labour force (ibid). Both these sectors provide enormous employment opportunities.

Workers are required to work in a very hot and humid environment, especially during summer. Almost all the activities of farm workers take place under direct sunlight, which may strongly increase heat stress. On the other hand, most of the industrial work is done indoor, but workers are exposed to the manmade heat created by the machines and other activities (Xiang et al. 2013). It has been reported that farm workers in the United States are four times more likely to experience heat-related illnesses than non-farm workers. This is due to the lack of occupational health and safety facilities at the farm and prolonged exposure to direct sunlight as compared to non-farm workers (Hansen and Donohoe 2003). In low-income and middle-income countries, lack of safety protocols, cooling facilities and heavy pace of work cause increased risk of heat stress for farm as well as non-farm workers. The most exposed occupations are farming, construction, transport and other labour work, which involves heat generation (Kjellstrom et al. 2009).

Pakistan is among the top 10 most vulnerable countries to climate change. It faces various seasonally varying climatic challenges like high temperature, low rainfall and other extreme events because of its geographical location. In addition, there are non-climatic issues, notably socio-economic challenges like rise in poverty, uncontrolled population growth and high dependence on agriculture sector. Zahid and Rasul (2010) analyze that the total change in humidity calculated during summer from 1961-2007 for entire Pakistan is 6.2% and total change in maximum temperature is 0.25°C A shift in heat index pattern from southern half of the country to the northern half has been observed along with a higher temperature during summer season. The trend of rising air temperatures has been observed from 1971-2000 in Faisalabad as well (Ibid). This increase in temperature reduces the well-being of the rural population by lowering agriculture production (Stocker et al. 2014; Kar and Das 2015). Increasing exposure to heat severely affects the production of wheat in Pakistan (Rasul et al. 2011). Similarly, drought leads to decline in the production of wheat, rice, cotton, and sugar cane.

This decline in production reduces the profitability of the tenant farmers and forces them to alter their income sources, or even relocate to urban areas (Majid and Zahir 2014; Saeed et al. 2016).

Migration could be an adaptation strategy to reduce the impact of climate change (Tacoil 2009). It provides the opportunity to reduce risk and diversify livelihoods (Scheffran et al. 2012). It also provides financial support to the families left behind through remittances, which helps them enhance their capacities to adapt and to invest in new sustainable livelihood options (Ibid). Migration also has a skill-enhancing potential through knowledge transfer and increasing access to modern technologies and skills (de Haas 2006). Extensive literature is available that examined the link between climate change (extreme events related to temperature, precipitation and other quantities) and migration, considering it as an adaptive strategy to overcome the impact of climate change on livelihoods (Branett and Webber 2010; Mueller et al. 2014; Saeed et al. 2016).

Migration is a continuous process. People move from one place to another to permanently settle at a new location. Most of the time people relocate themselves from remote areas to developed areas for better livelihood and to improve their standard of living. In this context, the rural population of Pakistan declined by 10 per cent from 1996 to 2015 whereas during the same period the urban population increased by 22 per cent (Hussain 2014). Structural transformation in the economy and the reallocation of resources from agriculture (with lower productivity) to industry and services (with relatively high productivity) are the drivers of migration in Pakistan (ibid). According to the State Bank of Pakistan (2015), high input prices, water stress, climate-related events (flood, drought and heavy rain) affect the productivity of agriculture sector, which leads to decline in the earning of rural population. In Pakistan, a statistically significant relationship between heat stress and migration has also been reported (Mueller et al. 2014). Extreme heat stress is found to be associated with more migration because it affects the livelihood by reducing the farm and non-farm income (Ibid). However, a direct link between heat stress and migration decisions has not yet been established. Such a link may exist because the working capacity of outdoor workers in developing countries is also compromised due to heat stress (UNDP 2016; Venugopal et al. 2015; Kjellstorm 2016). It has been found that heat stress negatively affects workability and health conditions of the micro and small industrial workers in Pakistan (Butt 2012). Furthermore, the available adaptive opportunities are not sufficient to provide the desired level of thermal comfort in summer (Nicol et al. 1999).

This study is an attempt to understand the direct relation between migration decisions and heat stress. It will examine not only the impact of heat on livelihoods, but also take into account explicitly the impact of heat stress or thermal comfort level at home as well as at workplace. Further, this study explains how heat stress affects the workability of the workers, what type of work is more exposed to heat stress, how is the level of income associated with discomfort at workplace and at home and to what extent these stresses play a role in migration decision and the choice of new destination.

This study has been structured into four sections. Section 1 provides an introduction of the study. Section 2 explains the methodology, data collection technique and an overview of the study site. Section 3 states the results and discussion on the results, and section 4 draws conclusion based on the results and discussion.

2 Methodology

Focusing on the impact of heat stress on the worker's comfort level, and more specifically its role in the decision to migrate from rural areas to urban areas, this study uses a quantitative approach to understand the perception of different groups with regard to living and workplace conditions. For this given purpose, a comparison of two study sites, i.e. 1) Rural areas of Faisalabad district, and 2) Peri-urban areas of Faisalabad city, was drawn. At both sites, the available economic opportunities were analyzed along with the role of education and skills in the selection of a job/work. It was assessed what type of work is exposed most to heat. This information was related to the reasons that induce people to migrate. Finally, how effective is migration to improve the economic well-being and thermal comfort level of the migrants?

2.1 Data collection

To collect the data, a household survey was conducted by using a structured questionnaire for each of the sites to understand people's perception regarding their exposure to heat stress at home as well as at workplace, its impact on their health, sleeping quality and especially on the decision of migration. In rural areas, non-migrant households were interviewed whereas in peri-urban areas, migrant households were interviewed. Migrant households are defined as the households who migrated from rural to the peri-urban areas within the past five years and non-migrant households are those who have been living in rural areas for the past 40 years. A total number of 80 households were randomly selected for interviews in which 40 households were selected from rural areas (non-migrant) and 40 from peri-urban areas (migrant). The survey questionnaire was pre-tested and modified according to local needs before going into the field.

2.2 Study site

The study mainly focuses on the rural and peri-urban areas of Faisalabad district (Punjab province), Pakistan, which is located in the semi-arid region and has an agro-based economy. The agriculture sector contributes 30.9 per cent to the total employment of the district whereas industry and services sector contributes 34.4 per cent and 34.7 per cent to its economy respectively (Government of Pakistan 2011). About 52 per cent of the total population of the district lives in the rural areas and the majority population is engaged in agricultural activities. Faisalabad city, the third largest city of Pakistan, is characterised as a hub of the industrial and agriculture activities, as it has around 7,600 large to small-scale industrial units. It contributes around 25 per cent in the total export of Pakistan (Batool et al. 2010). The majority of urban population is involved in daily wage labour activities in various cotton and chemical industries as well as in the services sector. It is estimated that textile and its associated industries provide economic opportunities to around 10 million families. Therefore, it attracts potential rural labour force not only from adjacent areas but also frrm different parts of the country (ibid.). The working environment in the industrial sector is very poor; workers are exposed to various health hazards and injuries due to humidity, excessive heat, noise and improper lighting arrangements at workplaces (Shah et al. 2015; Khan et al., 2015).

Faisalabad district has a dry semi-arid climate that can be characterised by erratic rainfall and an increasing number of heatwaves (Saeed et al. 2016). In the past few years, this resulted in an increased frequency of crop failure and decline in crop yield (Muller et al. 2014). According to Farooq et al. (2005), the overall decline in farm income and jobs has caused an increase in rural-to-urban migration within the district. However, other factors such as low-paying jobs and lack of economic opportunities in rural areas, insufficient agricultural land and social discrimination of rural poor and landless communities also contributed to the rural-urban migration.

3 Results

3.1 Characteristics of the Respondents

In rural areas, the majority of respondents falls between 26 to 45 years. Among them, around 67 per cent have a secondary and above level of education whereas 37 per cent are uneducated (Figure 1). In the study area, agriculture is the main source of livelihood for the rural community; around 77 per cent of the respondents say that they depend on agriculture for their income (Figure 3). Their average monthly income ranges from Rs 2,500 to 100,000; 67 per cent of the households have an income above the poverty line (Rs 12,120 per household as per government definition).

On the other hand, people living in the peri-urban areas have a low level of income. Their average monthly household income ranges from Rs 3,000 to 30,000; only 33 per cent of the households have an income above the poverty line. It is observed that in urban/peri-urban areas, the occupation highly depends upon the level of education and professional skills. The study result shows that most of the respondents in the peri-urban areas are uneducated or have only low to middle level education (Figure 1) and is involved in daily wage labour activities for their livelihood (Figure 2). Only a small fraction of the total sample (5.4 per cent) has secondary or above level of education and has a job in the public or private sector.

Figure 7: Respondent's level of education

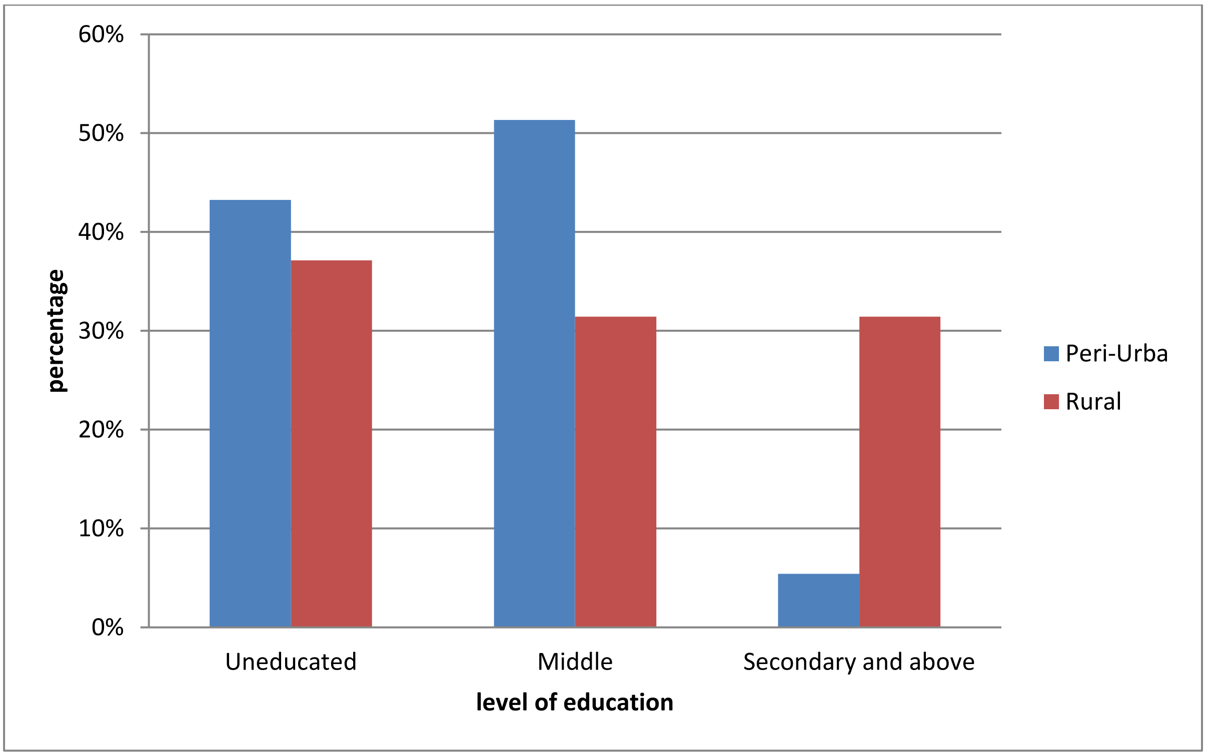


Figure 3: Type of occupation (Rural)

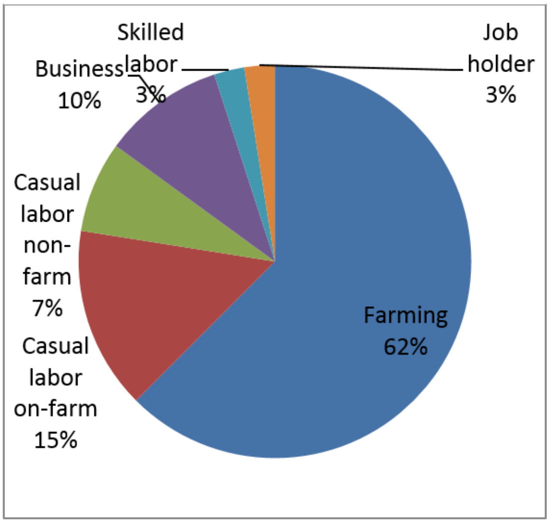
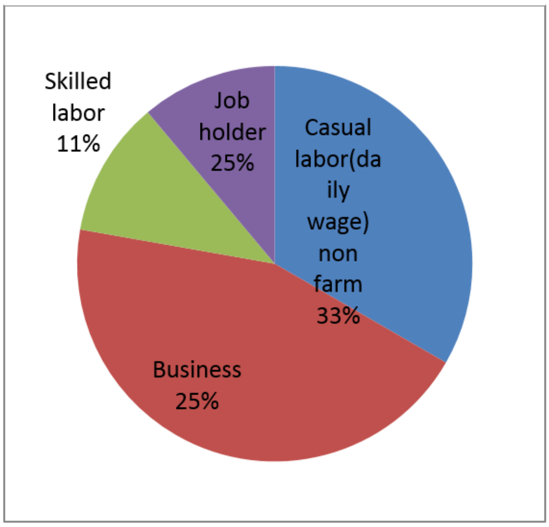


Figure 2: Type of occupation (Peri-urban)



3.2 Exposure to heat stress

Heat stress can be defined as any kind of physiological discomfort or stress as a result of direct exposure to sunlight or place of excessive exposure to heat (Hajizadeh et al. 2015). Heat stress is directly linked with environment and occupation. The exposure to heat stress will increase as a result of global warming if proper cooling facilities are not installed at such working environments. The farmer communities around the world, especially in Africa and Asia, are more vulnerable to climate change because of their sole dependency on agriculture for livelihood and low level of income, which squeeze their access to various adaptation measures such as use of machinery at farm and cooling equipment at home (Nilsson and kjellstrom 2010).

3.3 Occupational stressor

In the rural community as discussed above, the population usually depends on agriculture for its livelihood and a major part of the work takes place in fields. For this reason, almost all the farmers reported that they work under direct sunlight or a place of excessive exposure to heat during the summer (Figure 4). Around 98 per cent of the rural workers mentioned that their type of work makes them more exposed to heat. In rural areas, there is no proper system available to prevent them from heat stress during work. People usually cover their head with a piece of cloth and use shade as a shelter from the heat. Owing to this heat exposure and lack of preventive measures, almost all of the rural workers claimed that their productivity decreases in summer because this exposure to heat makes it difficult to work at full capacity during daytime.

In peri-urban areas, 40 per cent of the people are involved in daily wage labour, 25 per cent have their own businesses such as shops, construction, and transport services, and 25 per cent are salaried people. People who are involved in daily wage labour or have their own shops, or transport and construction businesses are reported to be more exposed to heat stress during summer (Figure 4). Around 89 per cent of daily wagers and 80 per cent of the business/transport/construction workers say that their type of work require excessive exposure to heat. To tackle the issue of excessive heat during work, various preventive measures such as shade, cooling equipment, i.e. fans and air-conditioners, and other safety measures (like a cap, hat, of piece of cloth to cover head) are used. About 40 per cent of this equipment is provided by the employers. Although the very basic cooling facilities are available to some extent, 37.5 per cent of the respondents still feel tiresome during work and 55.4 per cent think it is difficult to work.

Figure 8: percentage of respondents working under direct sunlight or place of excessive heat

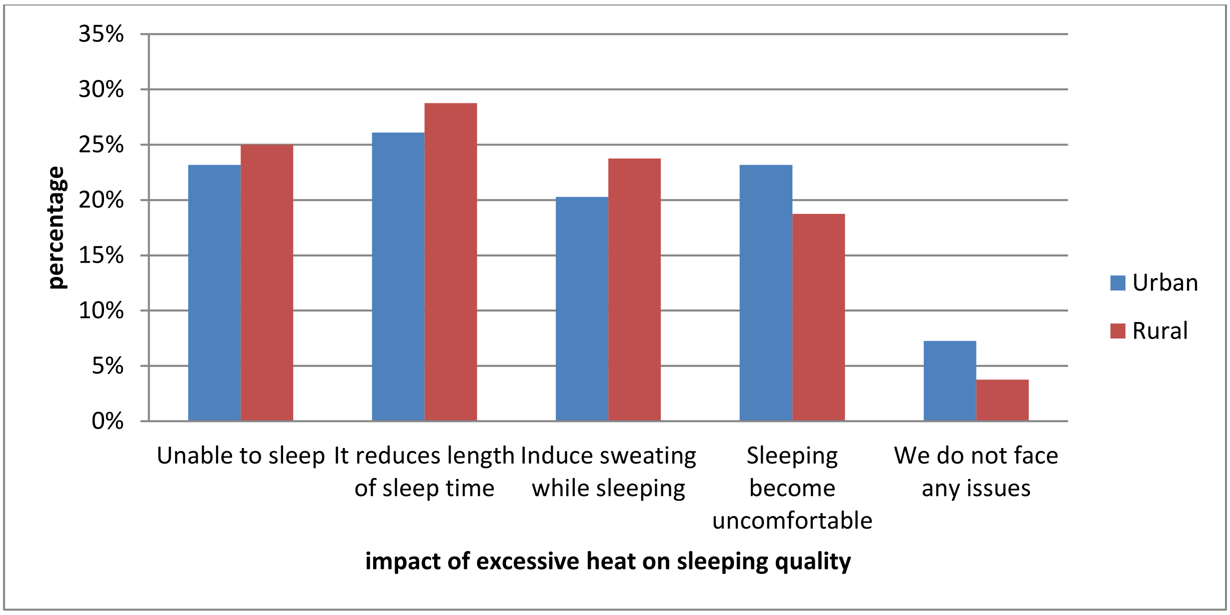
Note: These results are significantly different among rural and peri-urban areas at ($p<0.01$) level of significant.

3.4 Non-occupational stressor:

In peri-urban areas, 62.5 per cent of the respondents lives in the rented houses. These houses have two or few rooms with limited ventilation facilities where fan is the only cooling equipment because of financial constraints. Around 60 per cent of the respondents think that a fan along with continuous supply of electricity is sufficient for them to survive the heat. Though the situation of electricity supply is good in peri-urban areas as compared to rural areas, people still feel discomfort at the time of excessive heat in their small houses having less ventilation facilities as compared to houses in rural areas.

On the other hand, respondents who live in rural areas have their own houses comprising more than two rooms. Around 75 per cent of the houses are made of brick walls and t-iron roofs covered with a layer of soil. In 85 per cent of the rural houses, windows have been kept for better ventilation. A majority of the respondents use fans for cooling at home; only 2.3 per cent and 4.7 per cent use air conditioner or air cooler respectively. In rural areas, 58 per cent of the respondents are of the view that the available heat mitigating equipment is usually sufficient to fulfil their needs. On the days with excessive heat, a majority of the respondents face problems like reduction in sleep quality and time and heavy sweating during night-time (Figure 5).

Figure 9: Change in sleeping quality during excessive heat



Note: The difference between rural and peri-urban is insignificant

3.5 Impact of heat stress on health

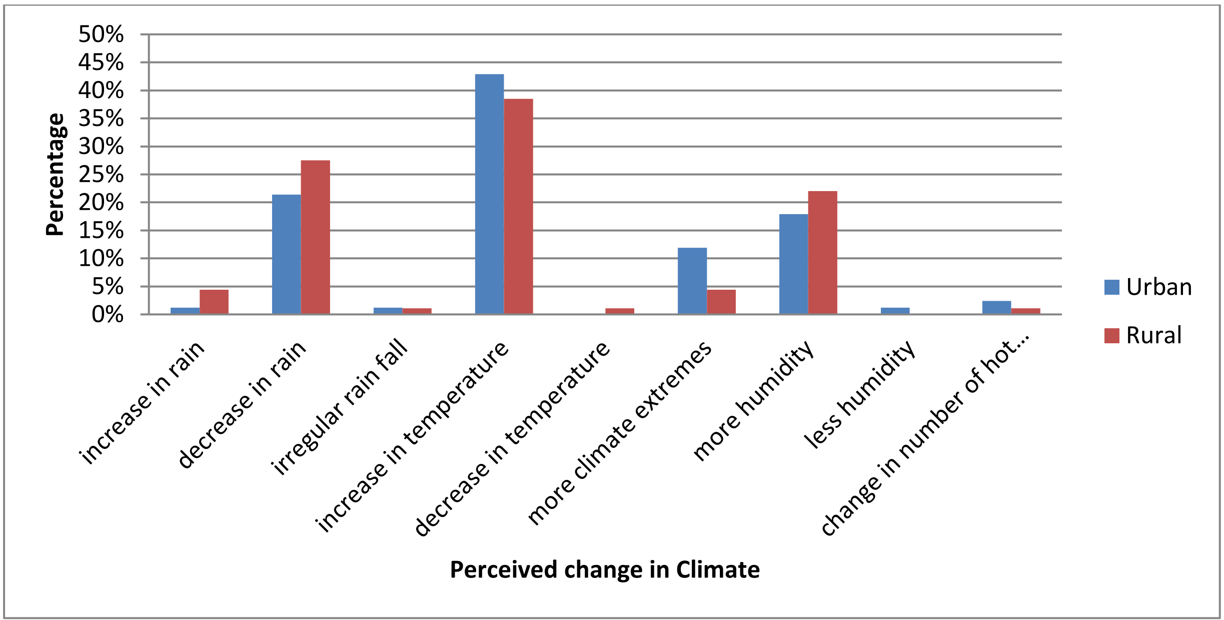
In our study area, people are mostly concerned about the health impact of heat stress. 97.5 per cent respondents from the rural community believe that heat can damage their health. Among them 77.5 per cent are very much concerned and 20 per cent are worried to some extent. The most common symptoms of the heat stress are intense thirst, reported by 16.1 per cent of the respondents, headache, by 13.4 per cent, low blood pressure, by 11.6 per cent, and dark urine, reported by 10.7 per cent of the respondents. To a question about the frequency of these symptoms, 46 per cent of the respondents claimed that they feel at least one of the symptoms twice a month.

Similarly, due to the hot working environment and load-shedding, the people of peri-urban community are also concerned about the impact of heat stress on health (92.5 per cent). The most common symptoms of heat stress reported in the peri-urban setting are headache by 16.7 per cent, dark urine by 25.7 per cent, intense thirst by 13 per cent, and finally heavy sweating by 11.1 per cent. As far as the frequency of these symptoms is concerned, 33.3 per cent of the respondents feel at least one of those twice a month while 25.6 per cent of the respondents suffer from any of these health-related conditions four to five times a month. At least 95 per cent of these affected people visit a hospital or a clinic if such symptoms occur. The quantity of solid food intake is also compromised due to excessive use of water during hot conditions. In peri-urban areas, 90 per cent of our respondents reported a decline in solid food consumption as compared to almost 82 per cent of the respondents in rural areas.

3.6 Perception about climate change and heat stress

A majority of the people interviewed in both rural (94.9 per cent people) and peri-urban areas (92.5 per cent people) are familiar with the term 'climate change.' People say that they have observed an increase in temperature and decline in rainfall during last decade; in addition, the occurrence of increased humidity in summer has also been noticed. In rural areas, most of the farmers report about a decline in rainfall, increase in temperature and humidity as major climate change indicators. On the other hand, the daily wage labour in peri-urban areas reports rise in temperature as major climatic change indicator. (see Figure 6 for detail).

Figure 10: Perceived change in the climate during past 10 years

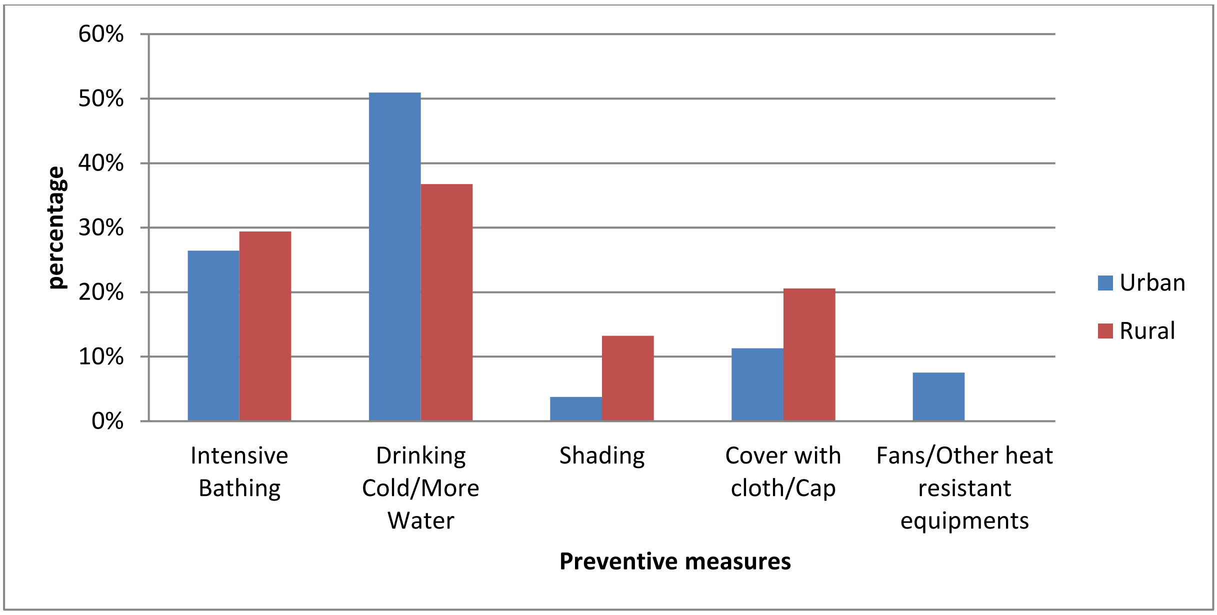


To a question about the impact of climate change on economic activities, 95 per cent of the rural respondents (the majority of which are farmers) agree with the statement that their economic activities have been affected by climate change, whereas in peri-urban areas 82.5 per cent (daily wager and job holders) agree with the statement. Owing to increase in temperature and humidity as a result of climate change, nearly 54 per cent of the rural community considers heat stress to be an important factor affecting their livelihood as compared to 44 per cent in the peri-urban area. The increase in the frequency of hot periods was experienced by 97.5 per cent of the respondents in the last decade, which further strengthened the idea of existence of heat stress. Self-experience and self-assessment are the most common sources of information about heat stress in both of these areas. In addition, the role of electronic media cannot be neglected regarding the spread of information about heat stress.

3.7 Awareness about the preventive measures of heat stress

Almost all the respondents are familiar with some traditional measures to prevent themselves against heat stress. Drinking large amount of cold water or other local or traditional beverages is the most common strategy among the part of the peri-urban population that either doesn't have the access to other cooling facilities or cannot afford those economically. About 51 per cent of the respondents drink large amount of cold water and 26.4 of the respondents use intensive bathing to prevent heat stress. While in rural areas, along with drinking cold water and intensive bathing, people mostly cover their head with a piece of cloth or cap and sit in the shade to prevent themselves from heat stress (see Figure 7 for details).

Figure 11: Most common strategies to prevent heat stress

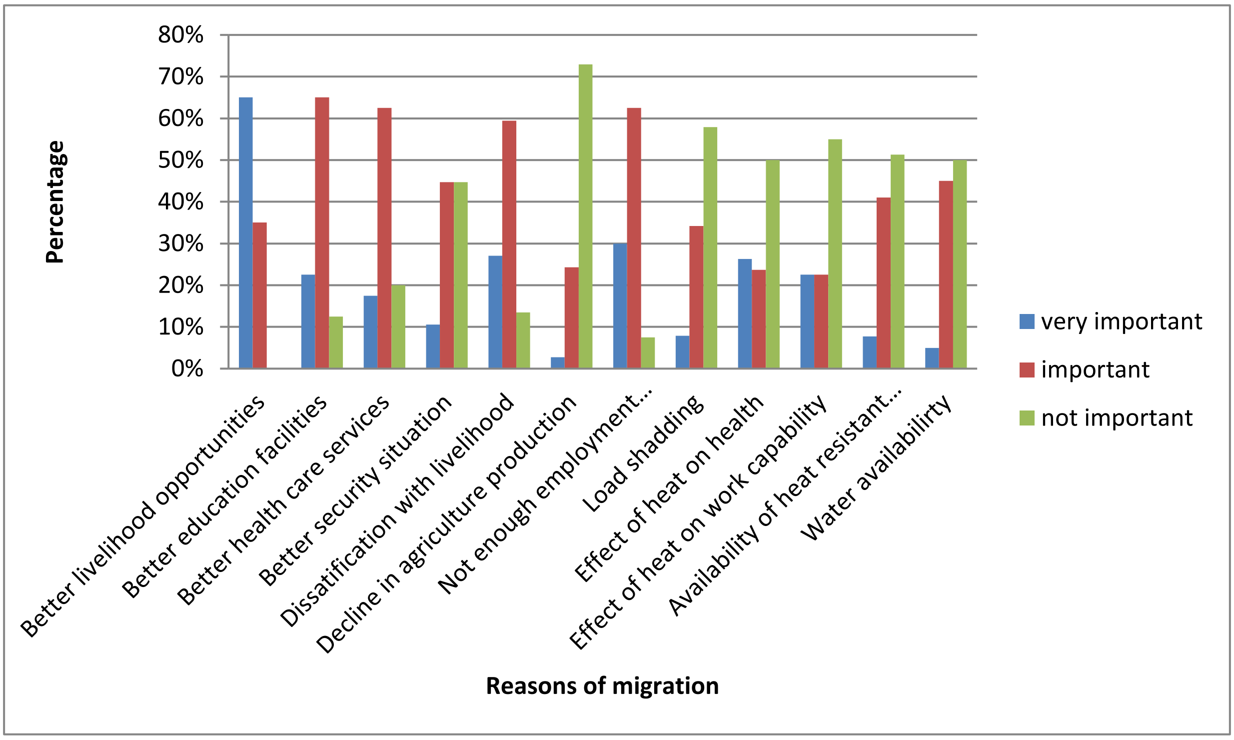


In our findings, the trend of visiting cooler places in summer is stronger in a rural community as compared to a peri-urban community because of the better economic strength and well-being in the rural community. Only 27.5 per cent respondents of the peri-urban areas live above the poverty line, as opposed to 55 per cent in the rural area (See Section 3.1).

3.8 Heat stress and migrant households

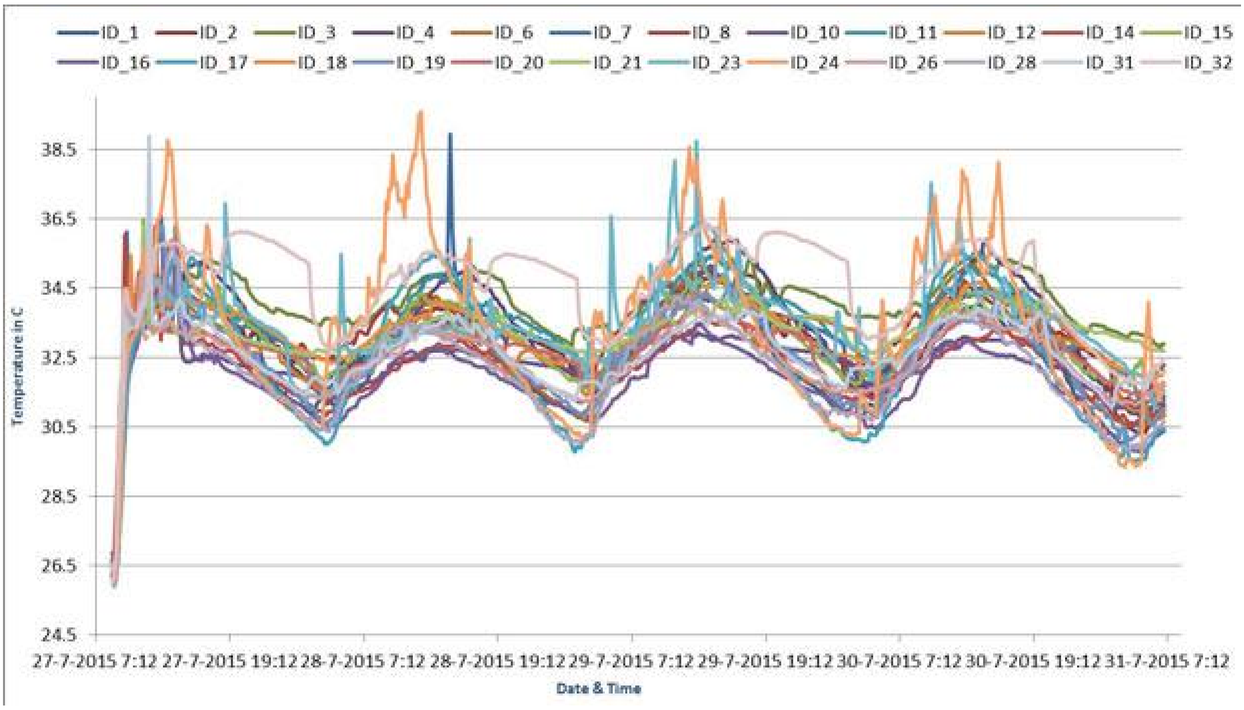
According to the results of the survey, around 72.5 per cent of the migrants in Faisalabad came from different rural areas of Faisalabad district and 27.5 per cent from other cities across the Punjab province. Among these migrants, 57.7 per cent have migrated for a better job, business or employment opportunity, around 26.8 per cent migrated for better health services, educational opportunities and for other basic facilities. No significant direct relation between climate change and the decision of migration (See figure 8 for detail) was reported. But, an indirect relation can be established through its impact on livelihood because around 82.5 per cent of migrants think their economic activities were affected by climate change at their previous locations. Search for better livelihood opportunities and dissatisfaction with the living standard are important factors in the decision of migration (See figure 8).

Figure 12: How important the following reasons are in migration decision (Peri-urban)



In response to the question about the type of migration, a majority living in peri-urban areas reported that they migrated with family; only 12.5 per cent of the respondents migrated alone. When asked about the change in overall thermal comfort level, a mixed response was found. In total, 45 per cent of the respondents claimed improvement in their comfort level because of better house construction and continuous electricity supply. On the other hand, 45 per cent of the respondents got discomforted because of less green area and high indoor temperature during night time, as the houses were less specious with less ventilation facilities (See graph 1).

Graph 1: Indoor temperature distribution



Graph shows indoor temperature distribution (in °C) amongst a selection of 24 households. A difference of around 3 °C degrees at some moments is observable between households during night time. **(Source: Photo story; warn nights in Faisalabad, Hi Aware; http://www.hi-aware.org/index.php?id=115)**

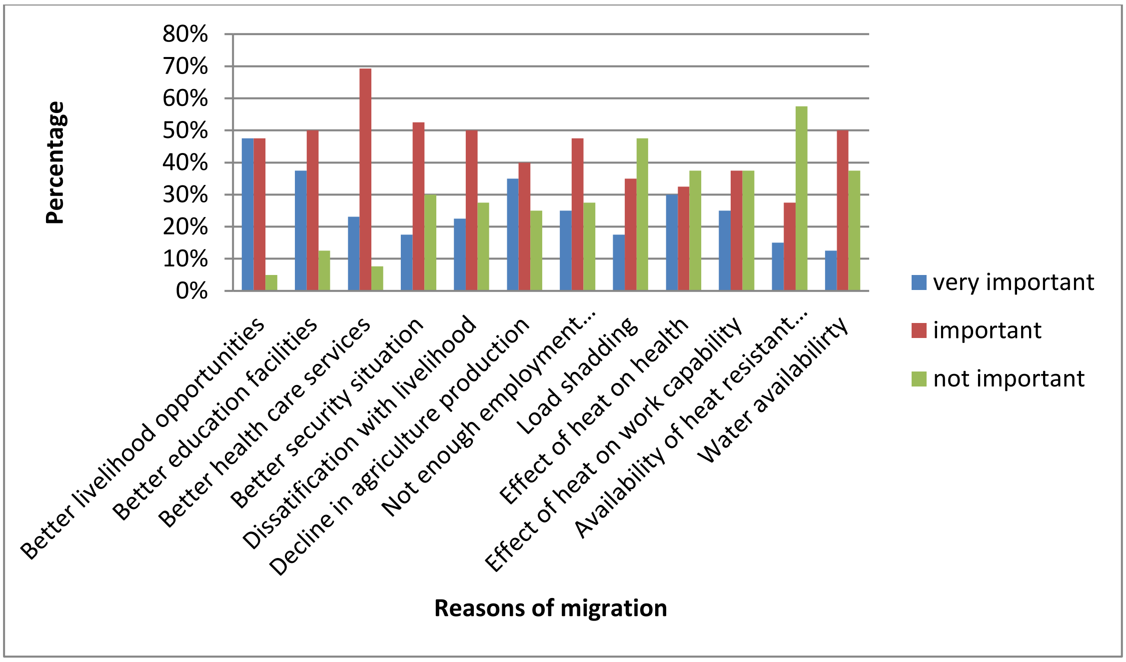
This study finds that people in peri-urban areas are more exposed to heat stress; 72.5 per cent migrant respondents reported an increase in heat stress at their current workplace as compared to their previous location. Whereas higher indoor night temperature due to the release of heat stored in buildings during daytime and high outdoor temperature due to less green areas are the major factors of thermal discomfort at home in urban areas (Franck et al. 2013).

3.9 Heat stress and non-migrant households

The rural economy of Faisalabad district has multiple dimensions in general. It is based on agriculture but non-farm activities such as labour work, transport, construction and personal local business are also quite popular in this region. Households having more than one source of income are very common, therefore, around 55 per cent of the households have an income above the poverty line. Despite the fact that people have diverse sources of income, they are still willing to move from the city.

In response to the willingness to migrate, 95 per cent of the people are willing to relocate out of which 79.5 per cent want to move to cities and 15.4 per cent want to move to any other village for a better livelihood, education and health facilities. The role of climatic factors in migration decision is gaining interest day by day. Decline in agriculture production due to climate extreme/change is important in migration decisions. On the other hand, the impact of heat stress on the workability of the people is also gaing momentum in migration decisions (see figure 9).

Figure 13: How important the following reasons are in future migration decision (rural)



Our results show that around 83 per cent of the respondents are thinking to change their profession after migrating to any city. Out of these, around 69 per cent of the respondents are willing to set up their own business or have a permanent job after migration. More than 52 per cent of the respondents think that if they change their profession after migration, it will reduce the exposure to heat stress at workplace. Similarly, nearly 58 per cent of the respondents think that their overall thermal comfort level will improve because of the continuous supply of electricity and availability of better cooling equipment. On the other hand, 30 per cent of the respondents think that their thermal comfort level will be compromised due to a high indoor temperature in less spacious houses and less green areas in cities.

4 Discussion

This study shows that people of Faisalabad district, who are involved in outdoor activities, feel that they are exposed to heat stress. Almost all the farm community and the group of daily wage workers in rural and peri-urban areas respectively work at a place of excessive exposure to heat (see Figure 4) due to various factors, including the influence of direct sunlight. Lack of availability of proper preventive measures further enhances their vulnerability to heat stress. In rural areas, people are usually responsible for arranging their own preventive instruments whereas in peri-urban settlements, most of the time the employer is responsible for providing safety protocols, cold drinking water, cooling facilities and shades These available safety measures are felt to be insufficient to reduce heat stress at workplace so that the productivity of the workers is reported to be compromised or declined.

Prevalence of heat stress at home is most common in peri-urban areas because of housing structures (See graph 1) and the majority of the respondents only have a fan to cool. That's why they are exposed to the high indoor temperatures in their less spacious houses as compared to rural respondents, and ultimately become more vulnerable. Many members of rural communities are comparatively less vulnerable because they have large houses with more than three rooms and a proper ventilation system. Regardless of these in-house structures, people usually feel similar discomfort while sleeping at night during summer. Additionally, people from both of the sites use excessive amount of drinking water at the time of excessive heat to prevent from heat stress.

People currently `having an income below the poverty line are most vulnerable to heat stress. The majority ``of the people, 61.8 per cent, who feel discomfort at the workplace are poor. Lack of the affordability of a spacious house, better cooling equipment, limited access to education and health facilities make them more vulnerable to occupational and non-occupational stressors. Poverty is the prime barrier to adaptation to heat stress. To secure their income, most of the daily wage workers have to work continuously for the whole day without break. Our results show that the adaptation measures provided by the employer are limited. None of the employers is provided any health insurance policy or first aid health facility to immediately respond to heat stress.

This study shows that people of Faisalabad district are aware of heat stress. Self-assessment is the most common source of information about heat stress, along with the electronic media. Concerning preventive measures, people usually don't have the proper knowledge and economic resources to adopt them. The majority population has adapted traditional measures to secure themselves from heat stress. Increase in temperature, the decline in precipitation, increase in humidity, increase in the frequency of heat stress and climate extreme events as a result of climate change affect the livelihood of the rural as well as the peri-urban community. Poor people are the most vulnerable to any climatic and socio-economic stressor. A majority of the rural population uses migration as an adaptation strategy to reduce socio-economic and climatic vulnerability. It has been evident from the literature that benefits of migration outweigh its costs (Mueller et al. 2014: Scheffran et al. 2012). Our study finds an increase in the level of income as a result of migration. Before migration, only 12.5 per cent households had a monthly income of more than Rs10,000 but after migration, this percentage has gone up to 35 per cent.

This study finds that people usually migrate to improve their level of income, reduce their vulnerabilities and improve their overall standard of living. Availability of better livelihood, health and educational opportunities attract them to move from deprived rural communities to urban settlements (see Figure 8 and 9). It is leant that that migration provides an opportunity to the people to improve their overall socio-economic wellbeing, but the rural poor having a low level of education and skills have only been able to improve their livelihoods to a limited extent. A majority of the rural labour migrants lives in peri-urban areas and they have a comparatively low-income status. They become more exposed to heat stress at their workplaces as well as at home because they face high indoor temperature in less spacious houses and less green areas.

On the other hand, this study shows that people, who are well-educated, have professional skills and high level of expected income may expect an improvement in the overall comfort level after migration. They have better chances to access well-constructed houses with better cooling facilities as well as the cooler working environment. It is found that the role of heat stress in the decision of migration in terms of its impact on thermal comfort level is not significant for our study areas. On the other hand, significant relation exists between heat stress and migration through its impact on livelihoods (Mueller et al. 2014) because people usually migrate to improve their level of income by improving their livelihoods.

5 Conclusion

This study provides an assessment of the workers who are exposed to heat in rural as well as peri-urban areas. It has been concluded that poverty is one of the key elements, which enhances the vulnerability of heat stress in rural as well as peri-urban areas. In order to earn a liveable income, poverty forces people to work even in a hot environment, without any break. As a result, the productivity of workers decline. In peri-urban areas, the limited income also reduces the workers' ability to take preventive measures at workplace as well as at home.

As the temperature is projected to rise in future, the probability of weather extreme events will also rise, which would result in increased vulnerability of the poor. The increase in temperature leads to an increasing frequency of hot days. As a consequence, people become more vulnerable to heat in terms of physical stress as well as its impact on livelihood. Nowadays, migration becomes a very common adaptation strategy to reduce socio-climatic vulnerabilities. Migration reduces livelihood vulnerabilities by providing more economic opportunities to the people, but its relation with the improvement of thermal comfort and heat exposure is very weak. Improvement in thermal comfort level is highly dependent on the level of income, type of work, and availability of heat resistant equipment.

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Annex 3: Summary of the workshop “Consultation on Climate Adaptation & Services for Water, Food, & Health Security,” 20-21 April, Pune, India.

Consultation on Climate Adaptation & Services for Water, Food, & Health Security

20-21st April 2017

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In the context of a changing climate there is tremendous potential for leveraging the vast knowledge generated in the field of research towards supporting vulnerable communities & groups as they adapt to these stresses and challenges. However, in order to achieve this it is necessary to overcome the barriers that stand in the way of translating knowledge into action. Key barriers to successful climate change adaptation are the lack of systematic knowledge, low levels of research-policy interactions and lack of successful business models which limit our ability to design policy, programmes, and services that enable households & communities to adapt to the challenges of climate change. Reducing these barriers requires closers interaction among researchers and those stakeholders (public, private and individuals) who determine how adaptation will finally occur.

In a step towards addressing these challenges, the Watershed Organisation Trust (WOTR) through its newly established Centre for Resilience Studies (W-CReS) in collaboration with Wageningen University, and Research (WUR) and with support from the European Commission, Canada's International Development Research Centre (IDRC), the UK Department for International Development & the Hindustan Unilever Foundation, hosted a Consultation on the 20-21st of April 2017 at the Four Points by Sheraton, Pune, with the goal of assessing existing synergies and disconnects between climate adaptation and services and enabling the formation of linkages between researchers and stakeholders. The event, over a period of two days, focused on question of climate change adaptation and climate services in the context of water, food and health security. The event presented a forum where researchers from India and Europe interacted with stakeholders from the government agencies, NGOs, the private sector and innovative small and medium enterprises in order to facilitate an exchange of knowledge and to develop new partnerships. The event brought together with a mix of government staff, private sector agencies, civil society, researchers and related experts.

Dr. Marcella D'Souza & Dr. Christian Siderius introduced the theme of the consultation. Then, the key note speakers addressed the audience.

Dr. Marcella D'Souza welcoming the participants to the consultation and introducing the key note speakers

- **Dr. B. Venkateswarlu , Vice-Chancellor,** Vasantrao Naik Marathawada KrishiVidyapeeth, Parbhani
- **Shri .R B Sinha**, **Joint Secretary, Gov. of India,** Ministry of Agriculture and Farmers Welfare, Dept. of Agriculture, Cooperation and Farmers Welfare, KrishiBhawan, New Delhi,
- **Dr. R.N. Kulkarni, Chief General Manager,** NABARD
- **Mr. Ravi Puranik, CEO**, Hindustan Unilever Foundation

R.B Sinha addressing the audience at the inauguration of the consultation.

Followed by the introduction, the key note speakers shared their thoughts and ideas on the overarching theme of the consultation.

Dr. B. Venkateswarlu suggested that the solution for fighting climate change lies more in policy making than technology. While technology does play an important role but, at the policy level, such for a, like the consultation are needed to advocate the need to judiciously use water, energy and carbon".

Shri R. B Sinha focused on government's aim is to double farmer's income and increase irrigation and water use efficiency. However, he mentioned that the challenge identified is the changing cropping pattern and the behaviour of farmers. He spoke of the need for advocacy that bridges the gap between farmer's and policy makers. On a concluding note, he spoke about the need of creating a database of experiences and innovations carried outside the government research organization which are easily accessible.

Dr. R.N. Kulkarni, spoke on NABARD'S and WOTR'S relationship .He further added how technology and technical innovations need to be accompanied by institutional and other social monitoring mechanisms, infrastructure and investments that will allow them to achieve widespread penetration and adoption .

Mr. Ravi Puranik, commented on WOTR & HUFs relationship, and how the interventions that HUF supports have led to increasing in farmer incomes, while restoring the resource base. He also spoke about how given the anticipated effects of climate change it is important to think about how multiple sectors will interact and affect each other, and hence a consultation like this is timely & necessary.

The following were the key thematic areas for the consultation:

Food: In order to ensure food security, it is necessary to provide farmers with the informational andtechnical support that will enable them to respond to the challenges of climate change. The landscapeof climate services is characterized by several state, civil society and private sector actors whoprovide a variety of extension services including agro advisories primarily based on short termweather data. Key consumers of this information are farmers and rural communities. The scope foradvisory services in India is massive. In the state of Maharashtra alone, there are more than fivemillion farmers registered for these services. Generating locally relevant, dependable andtrustworthy information at this scale is a challenge that must be addressed. Higher levels ofcoordination between actors generating this information, the purveyors of these services, andfeedback from the final consumers of this information can vastly increase the utility of these services.

Ramdas Patil presented on farmers perspective on climate services

Water: Water Scarcity is one of the key challenges and will be so for the coming decades in India Asthe single largest consumer of water in the country, any consideration of water management must reflect the use of water for agriculture. Under this theme we shall explore issues across scales, from water use efficiency at the farm level, to aquifer management, to sub-basin and basin level challenges explore ways in which research and climate services can be leveraged to address these problems.

Veena Srinivasan presented on experiences in the Arkavathy river basin.

Heat Stress & Health: Despite several severe heat wave events in the past few years and projections by climate models of a warming climate and increasing frequency of extreme heat events in the coming years, public awareness of heat related hazards and risks remains at a minimal level. Administrations in India have only recently initiated “Heat Action Plans” in a few isolated regions. This, however, still lacks sufficient understanding of the issues for preparing adequate heat stress response plans. This theme will contribute to raising awareness of the problem of heat in South Asia, gathering and presenting evidence on appropriate measures to key stakeholders.

Dr. Christian Sederius presented on Outdoor heat stress in South Asia

The consultation ended with a valedictory and thank you. Here a draft document summarising the key points and policy recommendations that emerged from the consultation was discussed, which the participants agreed to develop further in the weeks after the consultation. A key point of consensus was the need for strengthening collaboration across different sectors and scales as it was felt that only these kinds of collaborations would allow us to generate effective climate services for better adaptation. A detailed report on the consultation will be shared in the coming weeks.

Participants at the consultation pose for a group photo before kicking of the deliberations

Annex 4: Report of the session "Migration, water management and climate change in glacial river basin and semi-arid regions in Pakistan: Key linkages and policy options", within the 20th Sustainable Development Conference (SDC), December 5-7, 2017, Islamabad, Pakistan.

Migration, water management and climate change in glacial river basin and semi-arid regions in Pakistan: Key linkages and policy options

Chaired by: Mr. Shams ul Mulk Former Chairman WAPDA
Guest of Honor: Mr. Nisar Memon

Moderated By: Dr. Imran Saqib Khalid, Sustainable Development Policy Institute, and Islamabad, Pakistan.

Speakers:
Dr. Kallur S. Murali, Senior Programme Officer, International Development Research Centre (IDRC), from India
Ms. Ayesha Qaisrani, Research Associate, Sustainable Development Policy Institute (SDPI)
Dr. Bashir Ahmed, Senior Scientific Officer, Pakistan Agriculture Research Council (PARC)
Dr. Imran, Research fellow, Sustainable Development Policy Institute (SDPI)
Mr. Muhammad Awais Umer, Research Assistant, Sustainable Development Policy Institute (SDPI)

Panel Organizers:
Ms. Ayesha Qaisrani , Sustainable Development Policy Institute (SDPI)
Mr. Kashif Salik, Sustainable Development Policy Institute (SDPI)
Dr. Bashir Ahmad, Pakistan Agriculture Research Council (PARC)

Reported By:
Ghamz E Ali Siyal, Sustainable Development Policy Institute (SDPI)

The session was initiated by Dr. Imran Khalid, SDPI, with welcome remarks and a brief introduction of session and the panelist. **Dr. Kallur S. Murali**, Senior Programme Officer, International Development Research Centre (IDRC), from India (Via Skype) gave program overview of Collaboratively Adaptation Research Initiative in Africa and Asia (CARIAA). CARIAA focuses on three hotspot areas namely, Deltas, Glacier fed river basins and Semi-arid region in Africa and Asia. It aims to generate knowledge, strengthen adaptation expertise and promote research uptake through research and policy engagement. This program is comprised of four consortia namely, Himalayan Adaptation, Water and Resilience (HI-AWARE), Deltas, Vulnerability and Climate Change: Migration and Adaptation (DECCMA), Adaptation at Scale in Semi-arid Regions (ASSAR) and Pathways to Resilience in Semi-arid Economies (PRISE). This program is based on cross cutting themes of migration, gender equality, economics, climate science and scenarios. CARIAA is a five year programme and it will end in 2019. It is jointly funded by International Development Research Centre (IDRC) and Department for International Development (DFID), U.K Government. Two of the four consortia, namely PRISE and Hi-AWARE are operative in Pakistan. To synthesize findings across the semi-arid regions and glacier fed river basins in Pakistan, CARIAA granted a small project to the two consortia under the Opportunities Synergies Fund (OSF). This project aims to collate findings on migration and water governance in the two hotspots within the purview of climate change impacts. Along with that capacity building of water professionals for implementation of water efficacy plans and engaging with policymakers for advocacy towards promoting adaptation options in water scarcity are important components of the programme.

Ms. Ayesha Qaisrani presented on the topic: Potential of Migration as an Adaptation Strategy in Semi-Arid Regions and Indus River Basins in Pakistan**.** The objectives of this study were to understand key climate vulnerabilities in semi-arid regions and Upper Indus Basin, drivers and patterns of migration and linkages between migration and livelihood resilience in these regions. Indus basin is dependent on upstream snow and ice reserves of Hindukush and Himalaya mountains. The major climate impacts are average rise in temperature, glacial retreat in Karakoram and Hindukush, thirteen glacier surges and increased frequency of Glacial Lake Outburst Floods (GLOFs), intermittent flash floods in Upper Indus Basin and erratic rainfall, rise in temperature and increased incidence of heat waves, droughts and floods in semi-arid regions, which collectively raise farm level risks and rural livelihood vulnerabilities also. Rural women are among the most exposed to climate risks because they have limited resources, low mobility which limits their capacity to manage climate risks. Migration is a common livelihood strategy and is gendered in nature. Drivers of migration in glacier fed river basins and semi-arid regions of Pakistan are food insecurity, low wage rates, lack of employment, quality education and health services, better wages in cities and job transfers. Livelihood resilience among migrant is better than non-migrants in semi-arid regions because of diversification of livelihood opportunities, remittances, innovation and establishing new social capital and networks. The migration is emerging as a positive force for reducing poverty and increasing resilience. There is a need for better management of migration, mainstreaming migration and migrants in development goals, planning and allocation of funds and investment in human capital especially in rural areas. Finally, she concluded by raising question for devising domestic migration policy for Pakistan which is also stressed under SDG 10.7 i.e. facilitate orderly, safe, regular and responsible migration and mobility of people, including through the implementation of planned and well-managed migration policies.

Dr. Bashir Ahmad from Pakistan Agriculture Research Council (PARC) discussed about dynamics of water governance including challenges, less focused aspect of water economy, climate change scenarios, food energy and water nexus and the way forward to sustainability. For enhancing water storage capacity, Pakistan has no other option to meet ever-increasing supply gaps than building medium and large reservoirs on urgent basis. The key challenges faced in water governance are system inefficiencies, deteriorating infrastructure in domestic irrigation and drainage, water logging and salinity, trans-boundary disputes, no consolidation and lack of clarity of roles and representatives at different administration level, no central monitoring information system. Climate change impacts are faced through change in annual mean temperature and uncertain precipitation which have impacted agriculture severely. Water storage capacity, marginalized ecosystem, inefficient irrigation system and reactive flood control rather proactive approach are less focused aspects of water economy. High efficient irrigation system has proved successful cases in the world. Pakistan has to transform either by force or by choice. It requires political will, enabling policies, huge investment and supportive industries. PARC is contributing its part by installing 8 physical models at farmers' field which have portable pumping system. Water scarcity is rising and irrigation water is only sustainable solution. He concluded that we need to move from subsidy to incentive based policies which should also include manufacturers and service providers along with farmers.

Dr. Imran Khalid from SDPI gave a brief introduction of project which focused on how institutions are working with regard to water governance, flood risk management and political economy. He described the major flood losses caused by 2010 floods and the dozens of institutions that are looking for disaster management like National Disaster Management Authority (NDMA) and Water and Power Development Authority (WAPDA), etc. The misperception of people about floods are religious misdeeds that led to wrath from God, India was responsible for letting out all the water to flood Pakistan and that, provincial governments are involved in breaching embankment etc. . The major reason for breaching of embankment was done on purpose or accidently due to lack of maintenance. The early warning system should be revamped and improved more in a people centric and gender inclusive aspect. There is need for technology transfer to people.

Mr. Muhammad Awais Umar discussed about heat stress conditions and their impact on migration decision. He stated that heat stress affects individual's attitude, performance and overall health who work under direct sunlight or physical work. Faisalabad has faced significant temperature rise which leads to increase discomfort and reduce productivity of worker and agriculture production. Migration can act as adaptation strategy to cope with impacts of heat stress on livelihoods by providing new diversified livelihood. For this study data was collected from Faisalabad district by randomly selecting 80 households; 40 from rural and 40 from Peri-urban areas. The rural respondents were defined as non-migrant whereas the peri-urban respondents were defined as migrant households. The results of study shows that workers who work under direct sunlight or place of excessive heat are more exposed to heat stress. Whereas exposure to heat stress at home is highly dependent on housing structure. Excessive use of cold drinking water is common preventive measure of heat stress for both of the types. While talking about migration as an adaptation this study found that; People usually migrate to improve their level of income, reduce their vulnerabilities (Socio-economic and climatic) and improve their overall standard of living. That is highly subject to their level of education and skills of the workers. Whereas the relation between migration and heat stress (thermal comfort) is very weak. He said that poverty is major factor which enhances the vulnerability to heat stress in rural as well as in peri-urban areas. Because poor' have to work continuously for whole day (without break) to secure their income. Furthermore lack of affordability of a specious house, insufficient cooling equipment and limited access to health facilities enhances their vulnerability. On the basis of these finding he proposed two recommendations. 1) Investment in human capital (skill, education, capacities, etc.) for better and effective productivity, and employment growth. 2) As an immediate response; availability of proper preventive measures and safety protocols at work place must be insured (especially in peri-urban areas).

Mr. Nisar Memon described that human security is central to water issue, climate change and policy management. World is facing fresh water and ground water availability issues and water management is fundamental for addressing droughts, diseases and livelihoods. Migration is a common adaptation strategy which is opted often. Historically, Pakistan has experienced three major incidents of mass migration: migration in 1947 with the creation of Pakistan, in 1971 people migrated after Bangladesh partition and migration after 1979 Afghan war. In terms of natural disasters induced displacement, incident of 2005 earthquake, flood of 2010, drought in Tharparkar displaced 1.6 billion and storms displaced 718 million people. Migration is considered as a challenge from development point of view but it is an opportunity as well. Rather than considering it as negative, or anti-city, migration policy should be taken positively and pro-rural approach should be adopted. Remittances should be managed properly and through a people centric approach. He also stressed on the development of alternate livelihood opportunities at the rural level to better manage migration. Reverse migration as an active government policy for reducing urban pressure. In order to improve agriculture sector, there is need for introducing proper pricing mechanism along with subsidy and incentive based mechanism. There is need for shifting from resilient to anti-fragile system.

Mr. Shams ul Mulk, former Chairman WAPDA, discussed about the historical floods experienced in Pakistan and the existing institutional framework and functional activities of WAPDA. After floods of 1929, severe floods of 2010 were felt by Pakistan which could occur 1 over 10,000 years. We need to look at our history of flood management. WAPDA was considered prime institution to handle with water management issues. After losing three rivers, WAPDA was considered responsible for meeting gaps of supply and demand. Building Mangla dam was one of big challenges but institutional capacity was a key in achieving it. We need to carry out capacity audit of institutions. We have to start diverting our attention to institutions and their capacity building. Pakistan is facing serious problem of glacier melting, water scarcity etc. but unfortunately politically we are not on same page. He concluded with a hopeful remark that next year we would have moved forward from current situation.

During questioning answer session, three questions from audience were raised about agriculture extension, progressive farmers and water efficient utilization. First, does initiation of NGO's extension can be a viable solution in place of government extension services? Secondly, progressive farmers are neglected, what should be done to counter such behavior and provide incentive to them? Thirdly, how water usage can be efficient in Pakistan? Along with that one of the participants from audience commented that we should also include migration of half million from South Waziristan in our discussions on population flows. Another recommendation came from audience that there is need for awareness programs in rural and urban areas to address these core issues. Dr. Basheer answered that Private organizations like NRSP has its deep roots and these organizations should be included in partnership to reach out at local level. We also need to identify progressive farmers and highlight their efforts and encourage them. Mr. Nisar Memon answered that we need to build water storage dams and resolve issues by talks because we can't forget losses of 2010 flood incident. Along with that there is need for agro-zoning for setting pricing mechanism. Finally, Dr. Imran thanked all participants for joining in discussion of this session.