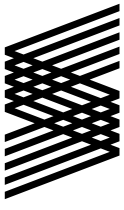
The role of heat stress in migration decisions: A case study of Faisalabad

Working paper



PRISE

Pathways to resilience in semi-arid economies

Research for climate–resilient futures

Role of Heat Stress in Migration Decision: A Case Study of Faisalabad

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Executive Summary

Heat affects attitude, health and performance of individuals. If heat exposure exceeds to certain threshold levels, this may result in discomfort, heat stress and other heat-related illnesses or even death.The people who work under direct sunlight (agriculture work) or place of excessive heat (industrial work) are extremely 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. Many developing countries face decline in workers' productivity as a result of heat stress.

Migration could be an adaptation strategy to reduce the impact of climate change, including heat stress. It provides an opportunity to reduce risk and diversify livelihoods. Extreme heat stress is found to be associated with migration because it affects livelihood and reduces farm and non-farm income,though any direct link between heat stress and migration decisions has not yet been established.

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 levels available at home as well as at workplace. It takes into consideration how heat stress affect the workability of the workers. Furthermore, 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 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. It was assessed as to what type of work is exposed mostly to heat and finally, how effective migration can improve economic well-being and thermal comfort level of the migrants.

The study finds that the people of both sites are well aware of heat stress; In addition to electronic media, self-assessment is the most common source of information. The 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.

The findings of this study 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 reduces livelihood vulnerabilities by providing more economic opportunities to the migrants, but its relationship with improvement in 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 the 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 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 such as Europe, Africa, Asia and America. (Field 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 (GoP 2017). The role of industrial sector is also important in terms of its contribution to GDP and provision of employment opportunities (ibid).

Workers are required to work in a very hot and humid environment, especially during summer. The most exposed occupations are farming, construction, transport and other labour work, which involves heat generation (Kjellstrom et al. 2009). 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 heat created by the machines and other operational activities (Xiang et al. 2013). It has been reported that the 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.

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 including rise in poverty, uncontrolled population growth and high dependence on agriculture sector. Zahid and Rasul (2010) state 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 to 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 farmers and forces them to alter their source of income or even opt to migrate to urban areas (Majid and Zahir 2013; 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).

Throughout the history migration is found to be 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 has been declined by 10 per cent from 1996 to 2015 whereas during the same period the urban population has been increased by 22 per cent (Hussain 2014). Structural transformation in the economy and 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 been noticed (Mueller et al. 2014). Extreme heat stress is found to be associated with more migration because it affects the livelihood by reducing 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 working capacity of outdoor workers in developing countries is compromised due to heat stress (Venugopal et al. 2015; Kjellstorm 2016). It has been found that heat stress negatively affects workability and health conditions of 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 techniques 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, this study uses a quantitative approach to understand the perception of different groups with regard to living and workplace conditions. For this 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 as to 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 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, sleep 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 that migrated from rural to the peri-urban areas within past five years and non-migrant households are those who have been living in rural areas for 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), which is located in the semi-arid region and has an agro-based economy. The agriculture sector contributes 31 per cent to the labour market of the district, whereas industry and services sector contributes 34 per cent and 35 per cent respectively to its economy (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 from different parts of the country (ibid.). The working environment in the industrial sector does not correspond to the safety and enviromental standards; 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).

The Faisalabad district has a dry semi-arid climate that can be characterised by erratic rainfall and an increasing number of heat waves (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.

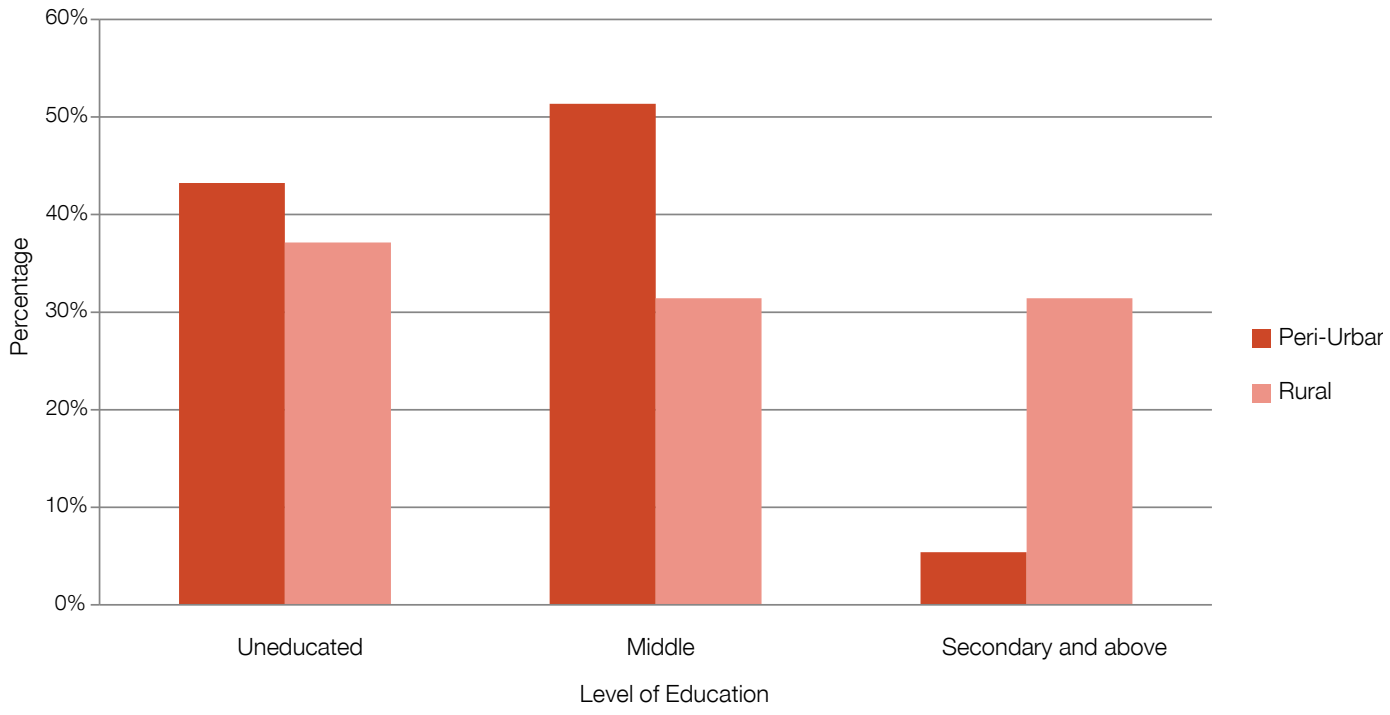
3. Results

3.1. Characteristics of the Respondents

In rural areas, the majority of respondents falls between 26 to 45 years. Among them, around 31 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; 55 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 28 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 results show that most of the respondents in the peri-urban areas are uneducated or have only low to middle level education (Figure 1) therefore, majority of them are 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 public or private sector.

Figure 1: Respondents' level of education



Source: Authors' own

Figure 2: Type of occupation (Peri-Urban)

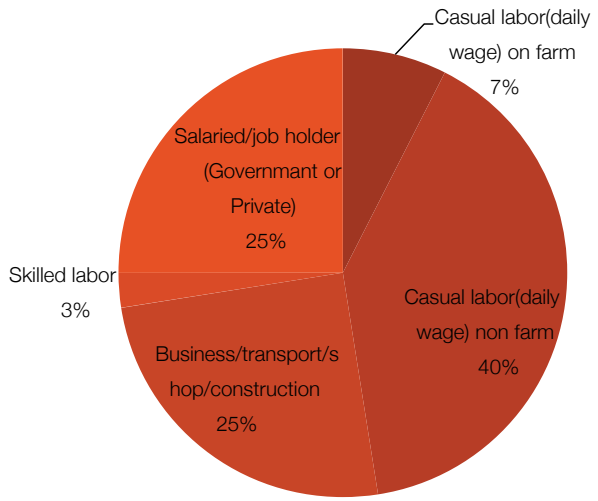
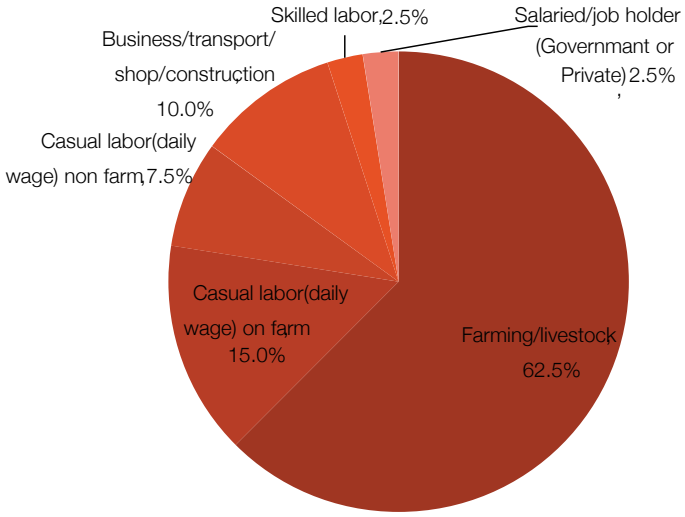


Figure 3: Type of occupation (Rural)



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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 than the countries in the North 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).

3.2.1. 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 their 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. The 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 results in 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, a hat, a of piece of cloth to cover head) are used. About 40 per cent of employers provide these equipment's. Although the very basic cooling facilities are available to some extent, 38 per cent of the respondents still feel tiresome during work and 55 per cent think it is difficult to work.

Figure 4: 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

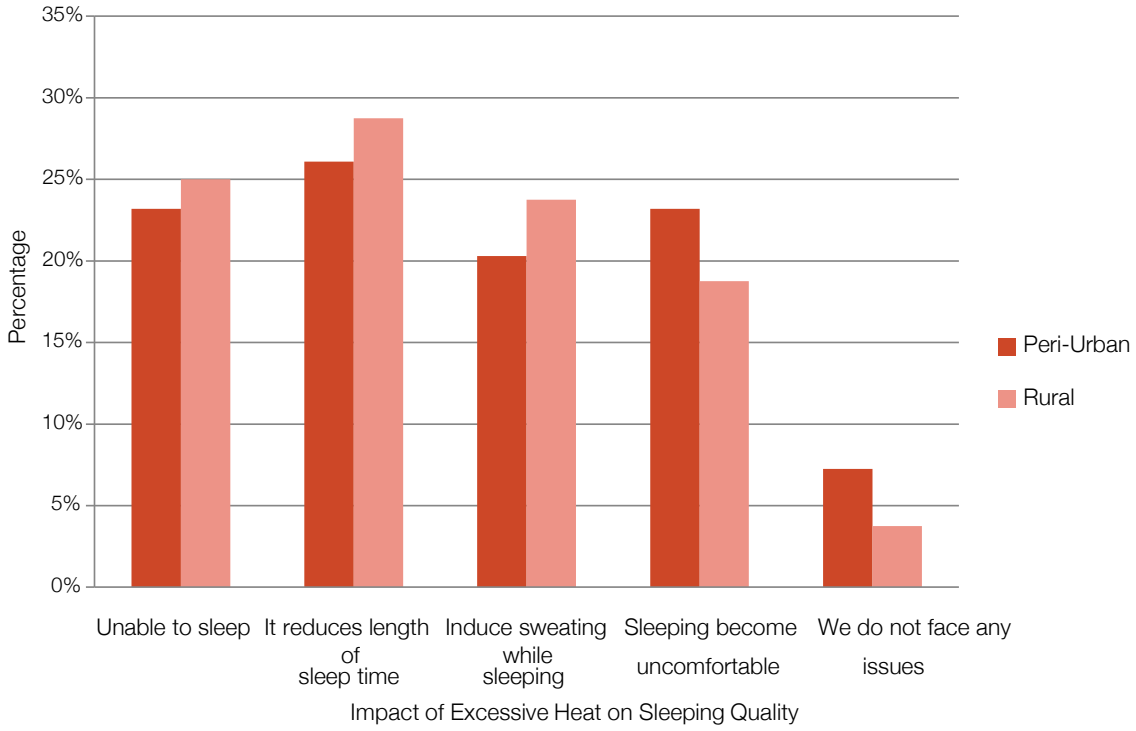
Source: Authors' own

3.2.2. Non-occupational stressor

In peri-urban areas, 63 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, the 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 per cent and 5 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 5: Change in sleeping quality during excessive heat



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

Source: Authors' own

3.3. Impact of heat stress on health

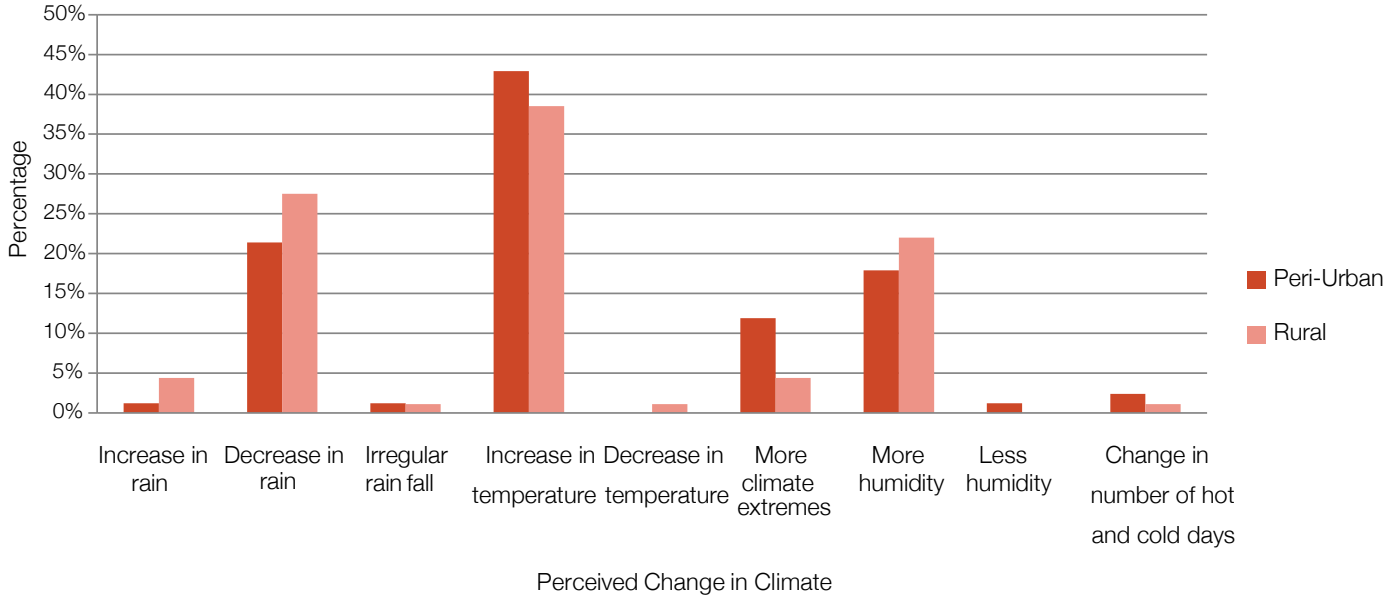
In this study area, people are mostly concerned about the health impact of heat stress. The 98 per cent respondents from the rural community believe that heat can damage their health. Among them, 78 per cent are very much concerned and 20 per cent are worried to some extent. The most common symptoms of the heat stress are intense thirst, as reported by 16 per cent of the respondents, headache, 13 per cent, low blood pressure, 12 per cent, and urine of abnormal colour, was reported by 11 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 (93 per cent). The most common symptoms of heat stress reported in the peri-urban setting are headache by 17 per cent, abnormal colour of urine by 26 per cent, intense thirst by 13 per cent, and finally heavy sweating by 11 per cent. As far as the frequency of these symptoms is concerned, 33 per cent of the respondents feel at least one of those twice a month while 26 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 say they 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.

3.4. Perception about climate change and heat stress

A majority of the people interviewed in both rural (95 per cent people) and peri-urban areas (93 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 6: Perceived change in the climate during past 10 years



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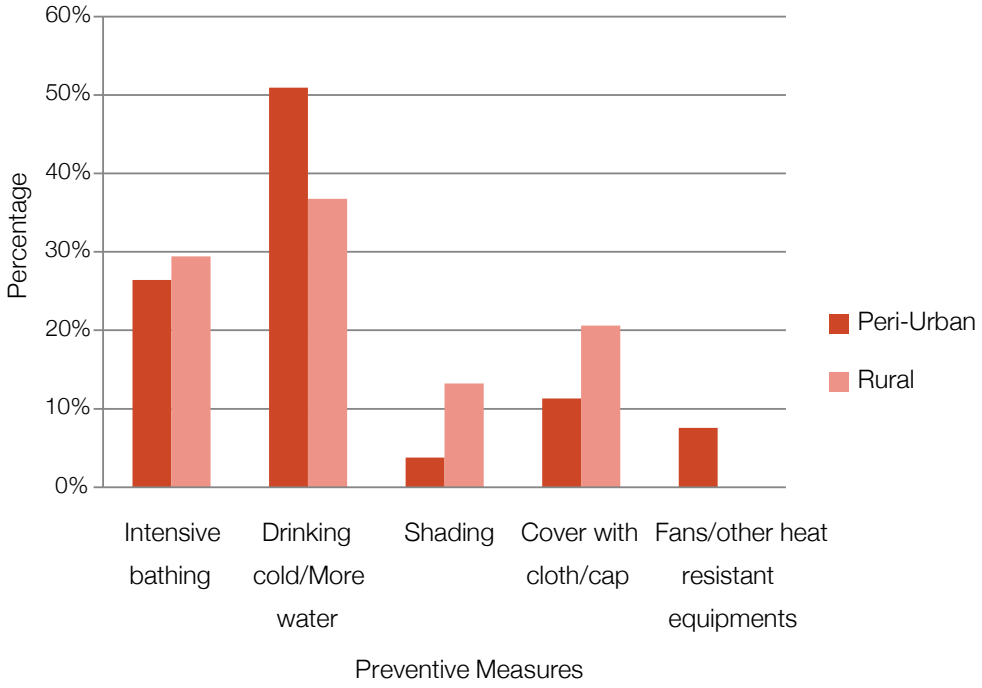
To a question about the impact of climate change on economic activities, 95 per cent of the rural respondents (the majority of which are farmers) agree with the statement that their economic activities have been affected by climate change, whereas in peri-urban areas 83 per cent (daily wager and job 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 98 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.

3.5. 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 of the respondents use frequent bathing to prevent heat stress. While in rural areas, along with drinking cold water and frequent bathing, people mostly cover their head with a piece of cloth or cap and sit in the shade at regular internval to prevent themselves from heat stress (see Figure 7 for details).

Figure 7: Most common strategies to prevent heat stress



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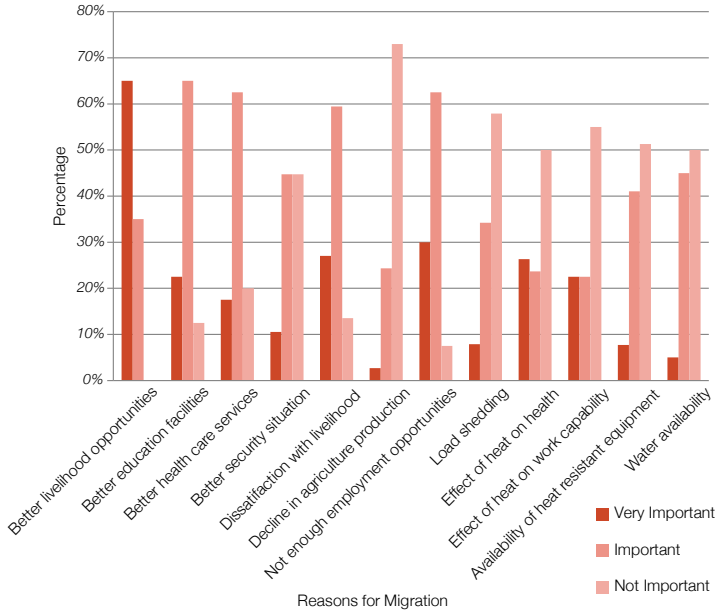
In our findings, the trend of visiting cooler places in summer is stronger in a rural community as compared to a peri-urban community because of the better economic strength and well-being in the rural community. Only 28 per cent respondents of the peri-urban areas live above the poverty line, as opposed to 55 per cent in the rural area (Poverty line: cost of basic need per adult equivilant Rs. 3,030) (See Section 3.1).

3.6. Heat stress and migrant households

According to the results of the survey, around 73 per cent of the migrants in Faisalabad came from different rural areas of district and 28 per cent from other cities across Punjab province. Among these migrants, 58 per cent have migrated for a better job, business or employment opportunity, around 27 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. Around 83 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).

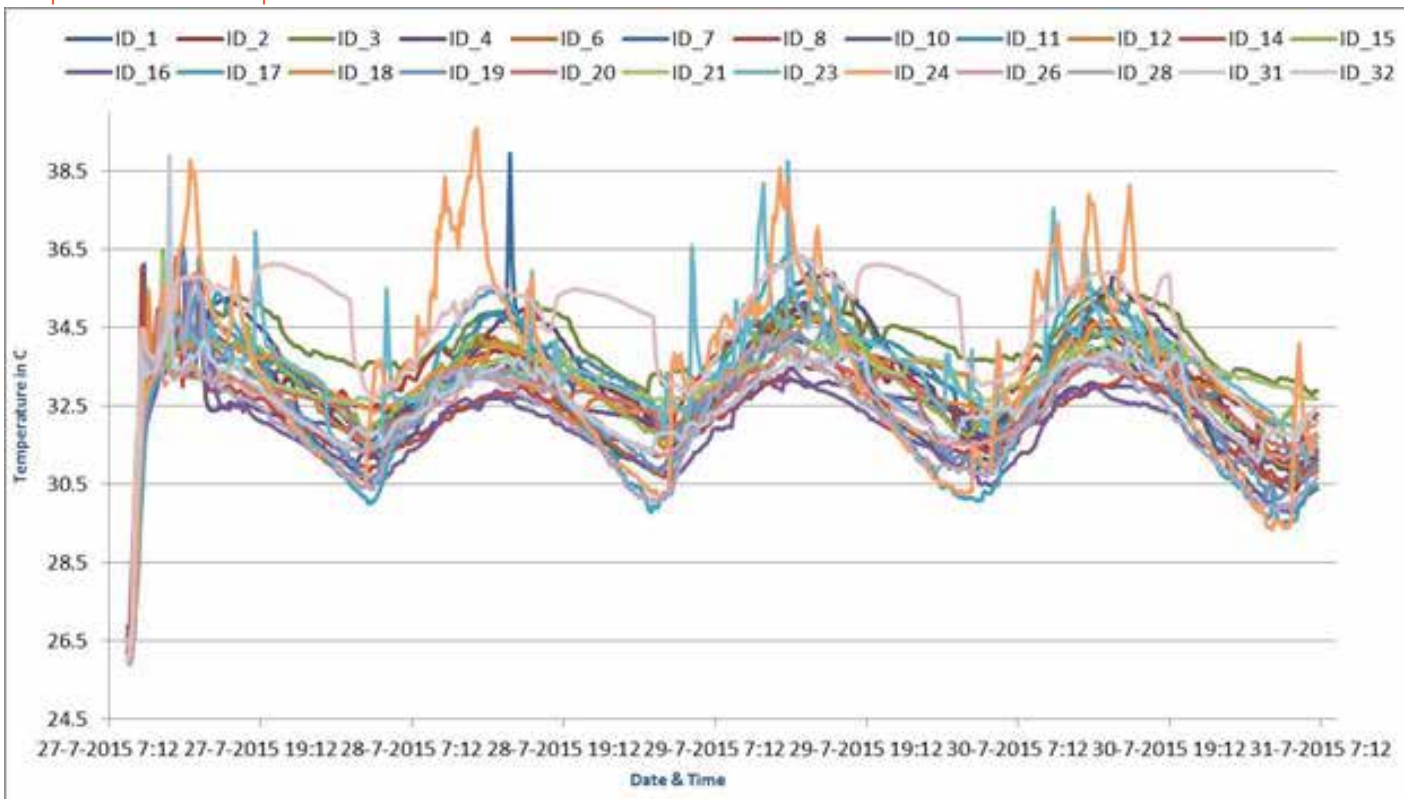
Figure 8: How important the following reasons are in migration decisions (Peri-Urban)



Source: Authors' own

In response to the question about the type of migration, a majority living in peri-urban areas reported that they migrated with family; only 13 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 reported being uncomfortable due to lacck of green spaces and high indoor temperature during night time, as the residences were less spacious 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; warm nights in Faisalabad, Hi Aware; http://www.hi-aware.org/index.php?id=115)

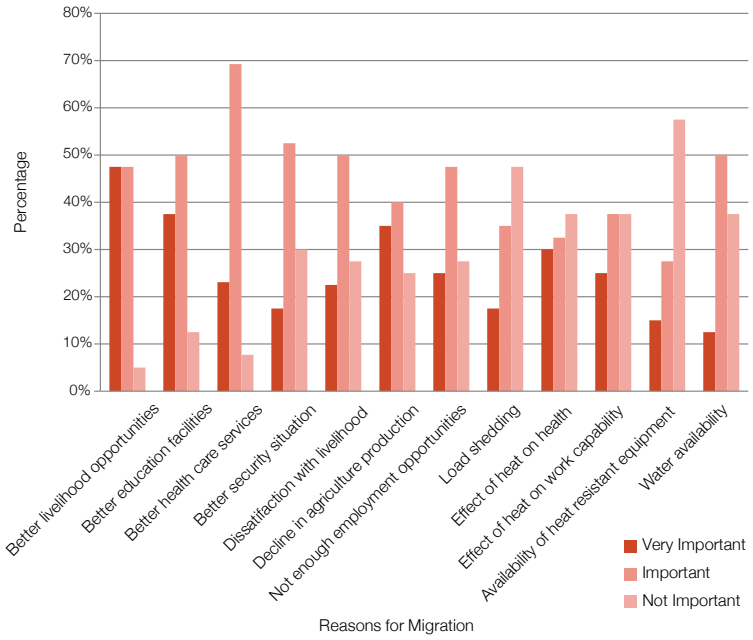
This study finds that people in peri-urban areas are more exposed to heat stress; 73 per cent migrant respondents reported an increase in heat stress at their current workplace as compared to their previous location. Whereas higher indoor night temperature due to the release of heat stored in buildings during daytime and high outdoor temperature due to less green spaces are the major factors of thermal discomfort at home in urban areas (Franck et al. 2013).

3.7. 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 67 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 80 per cent want to move to cities and 15 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 increasing 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 being quoted as one of the factors leading to migration decisions (see figure 9).

Figure 9: How important the following reasons are in future migration decisions (rural)



Source: Authors' own

Our results show that around 83 per cent of the respondents are thinking to change their profession after migrating. Out of these, around 69 per cent of the respondents are willing to set up their own business or find a permanent job. 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 are of the opinion that their theral comfort level will be compromised due to a high indoor temperature in less spacious residences and less green areas in cities.

4. Discussion

This study shows that the people of Faisalabad district, who are involved in outdoor work related 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 the 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 Our reserach shows that these available safety measures are insufficient to reduce heat stress at workplace, hence the productivity of the workers is compromised.

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 residences as compared to rural respondents, and ultimately they 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, the people usually feel similar discomfort while sleeping at night during summer. Additionally, the people from both sites use excessive amount of drinking water at the time of excessive heat to prevent from heat stress.

the people currently having an income below the poverty line are most vulnerable to heat stress. The majority of the people, 62 per cent, who feel discomfort at the workplace are poor. Lack of 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 a 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 coping measures provided by the employer are limited. None of the employees is provided with health insurance policy or first aid health facility to immediately respond to heat stress at the workplace.

This study shows that the people of Faisalabad district are aware of heat stress. Self-assessment is the most common source of information about heat stress along with the information broadcast by electronic media. Concerning preventive measures, the people usually don't have the proper knowledge and economic resources to adopt such measures. The majority population has adapted to traditional measures to secure themselves from heat stress. Increase in temperature, decline in precipitation, increase in humidity, increase in 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 13 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 the 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 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 are 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 the people who are well-educated and having professional skills and high level of 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 the people to 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 declines. 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 the increased vulnerability of the poor. The increase in temperature leads to an increasing frequency of hot days. As a consequence, the 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. The policy measures drawn from this study are given below;

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)

3) There should be a structured awareness campaign among the pepole on how to protect them and their relatives in case of rising heat and its related stress.

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