9 Community-driven vulnerability assessment and resilience building: cases from development contexts

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Summary

- Community-driven vulnerability assessment tools provide an insightful understanding of climate change impacts on natural resources and associated livelihoods.
- This chapter applies the Community Driven Vulnerability Evaluation Programme Designer (CoDriVE-PD) tool to assess vulnerabilities and associated impacts on natural resources in two Indian States.
- The findings in representative villages of defined typologies within a specific geography, give a landscape view of the vulnerability of socially-differentiated livelihood groups based on the 5-capitals framework.
- The findings help decision makers, natural resource managers, practitioners and communities to have a collective understanding of, and solutions for, climate change threats to important resources.

Introduction

The developing world suffers most the impacts of climate change. The need for having more robust, inclusive and sustainable adaptation options has been emphasized in the Paris Agreement and the 2015 Sustainable Development Goals (SDGs).

The role of natural resource management in supporting adaptation in developing countries is critical. About 41 per cent of the world's population, who are the poorest, inhabit dryland regions and depend heavily on natural resources to support their livelihoods.[1]

In the developing countries, high reliance on natural resources and limited adaptive capacities result in high levels of vulnerabilities among the communities. Climate variability and change add to the existing pressures that impinge upon livelihoods and well-being in the developing world.[2] Well implemented participatory watershed development has been proven to improve the quality of the natural resource base and enhance the livelihoods of the local communities. However, the climate variability experienced reduces the resilience of the people and the positive impacts that watershed development achieves.

To date, most initiatives that plan resource-based adaptation are top down and are drawn on particular plans and models. The engagement of the local community is limited; thus these initiatives lose the long experience and knowledge that people have on climate variability and its impacts. For community-based adaptation (CBA) to effectively contribute to building resilience, the importance, use and engagement of community knowledge are essential, not only to empower them, but to also secure their ownership which is essential for sustainability. While there are many instances where participatory tools have been used and communities have been involved in local and national level planning, such experiences mostly remain at the project level, where actions are restricted over time and space.[3]

This chapter discusses the Community Driven Vulnerability Evaluation c Programme Designer (CoDriVE-PD) as a framework for assessing the impacts of climate variability and non-climatic risks on the natural resources and associated livelihoods. The chapter draws on the experiences from two Indian states – Maharashtra and Andhra Pradesh – where the tool was applied to assess the vulnerability of communities and to include adaptation interventions into a community-engaging watershed management project.

The CoDriVE-PD was developed as part of Phase I of a 'Climate Change Adaptation' project supported by the Swiss Agency for Development and Cooperation (SDC) (see details of case studies in Annex 2). Phase I of the project involved: conducting research and developing tools to identify the climate risks experienced by communities in 48 villages in Maharashtra, Andhra Pradesh and Madhya Pradesh; conducting action research on new interventions implemented and assessing their impacts; and developing a participatory methodology for project implementation to build resilience of communities and their natural resource base. One of the objectives of Phase II of the project aimed to assess the vulnerability of communities applying the tool CoDriVe-PD in the Integrated Watershed Management Program (IWMP), a major state-funded programme in dryland regions of India. The IWMP has the specific aim of stabilizing the natural resource base and enhancing resilience of people.

The findings reveal that incorporating community-driven vulnerability assessments into the planning for watershed management projects, helps include adaptation interventions at various levels. Implementing this process through pilot projects at the state level is still nascent, but has been initiated with the state Governments of Maharashtra, Andhra Pradesh and Telangana.

Applying the tool CoDriVE-PD offers an opportunity to improve livelihood security in the face of emerging climate change impacts and other externalities. It also provides opportunities for its mainstreaming, along with an inbuilt mechanism for monitoring, evaluation and tracking adaptation.

Climate change in resource management

With about 69 per cent of its area being dry lands receiving less than 750 mm rainfall per annum, India is one of the most drought-prone regions of the world.4 Despite water scarcity, intense crop–livestock production is the mainstay of this predominantly rain-fed rural economy. Dry lands broadly face two major water-related challenges: high water runoff during monsoons causing soil erosion with siltation and regular water scarcity caused by poor rainfall.

While various natural resource management projects exist in India, watershed development (WSD) is India's leading strategy and constitutes the largest development intervention to improve productivity of the dry lands of the country.[5] The IWMP is a major programme that aims "to restore the ecological balance by harnessing, conserving and improving degraded natural resources such as soil, vegetative cover and water". The expected programme outcomes include "prevention of soil run-off, regeneration of natural vegetation, rainwater harvesting and recharging of the ground water table, thus providing sustainable livelihoods to the people residing within the watershed area".[6] Through systematic implementation, WSD projects such as the IWMP provide a range of tangible benefits including enhanced economic returns and livelihood security.[7] Other studies found that treated areas have reverted to their original condition,[8] possibly due to diminishing benefits of WSD triggered by anthropogenic development and livelihood-related externalities. These studies advocate the need to re-examine planning processes.[9]

Major concerns that have been given little attention in WSD programmes are climate change and the exacerbating anthropogenic pressures on the watersheds. Specifically, the role of climate change and its impacts on the outcomes of natural resources regeneration initiatives was not well understood by programme planners and policy makers. Frequent droughts and long dry spells destroy the vegetative cover and impact agriculture production; while excessively heavy rainfall may cause small landslides, heavy erosion or even water logging in farms. These can be prevented by including appropriate land husbandry interventions taken up in WSD programmes.

Because India has a high number of smallholder producers whose livelihoods depend on climatically-sensitive activities, revamping the WSD framework to consider climate change is essential. In this, it is important to identify emerging climate risks and externalities in a participatory manner and develop mainstream adaptation options into programme design. This will ensure that ecological and social benefits of WSD are realized and made sustainable.

The Watershed Organisation Trust (WOTR) applied its long experience to support climate mainstreaming in the institutional and technical aspects of WSD using participatory tools.

Approach employed in the assessment

About CoDriVE-PD

This is a science-based tool developed by combining key features from three international research methodologies, namely Driver-Pressure-State-Impact-Response (DPSIR); The UK Department for International Development's Sustainable Livelihoods Framework, and Community-based Risk Screening Tool – Adaptation & Livelihoods - CRiSTAL. Using CoDriVE-PD helps make a quick but precise assessment of the climate risks and vulnerabilities of an area through rigorous community engagement. It helps build a vulnerability context; identifies climate risks and trends; builds an adaptation response/coping mechanism inventory that aids evaluation and tracking; and provides a five-digit multi-dimensional 'vulnerability code' based on the five livelihood capitals (financial, human, natural, physical and social) and backed by a list of locale-specific indicators. The Indicators were assessed using the resilience scale to rate vulnerability. Where : 1= Nil resilience (0-10%) indicates Very High Vulnerability – (Red: Danger), 2: Minimum resilience (11-25%) indicates High Vulnerability (Orange: Risk), 3: Low Resilience (26-45%) indicates Medium Vulnerability (Yellow: Alert), 4: Medium Resilience (46-70%) indicates Low Vulnerability (Blue: Stable) and 5: High Resilience (71% and above) indicates Very Low Vulnerability (Green – Safe).

Identifying these indicators reduces risks that can arise by using broad or pre-determined indices that prove inappropriate in a local scenario. The vulnerability context uses current and past data, including: sector-wide drivers and pressures of change; trends in temporal climate risk mapping and impacts on communities; an inventory of adaption responses/coping mechanisms and the status of sector-wide traditional knowledge systems in specific vulnerable localities. The tool can be applied at three levels: i) landscape/watershed/village level; ii) the level of vulnerable groups, capturing gender and social differentiation; and iii) production system level (e.g. agriculture, livestock, and fisheries). The tool can also be applied at different stages of a project cycle. By generating codes at each stage, CoDriVE-PD enables the longitudinal tracking of community adaptation responses, the monitoring and evaluation of activities and decision support. The tool may be rolled out rapidly or intensively, as required. For intensive rollout, the number of days needed is based on the type of quantitative assessments or household level surveys being conducted. CoDriVE-PD is supported through a web based application[9] to help a quick processing of the results and facilitate application at scale.

Steps in applying the CoDriVE-PD tool

The study focused on two sites in the states of Maharashtra and Andhra Pradesh where the IWMP project was implemented. The three steps employed were: identification of study sites, application of WOTR's CoDriVE-PD in representative villages and providing suggestions for suitable adaptation measures into local-level project planning.

The first step involved identifying and characterising study sites. This entailed grouping villages based on similarities (typologies) of bio-physical, socio-economic and public infrastructure indicators using GIS-based methods. When applying the tool to larger scales, typology identification within the region takes into account regional heterogeneity. This was essential because varied socio-ecological contexts (location, water availability, land use and land cover characteristics, access to markets, culture) determine climatic and non-climatic vulnerabilities of resources and people.

The second step involved applying the vulnerability assessment tool – CoDriVE-PD – on the villages and vulnerable groups selected in each study site. Vulnerability codes and sub-codes (for different social groups and gender) were developed. These were supported by a list of context-specific vulnerability indicators. These IWMP projects were already underway, so assessments were conducted midway into project implementation. Communities were engaged in identifying indicators through multi-stakeholder meetings, focused group discussions, specific interviews with vulnerable groups and village transect walks to collect qualitative information. For quantitative data, secondary information from local government departments, baseline surveys and project feasibility reports were used. The selection and grading of assessment parameters were collectively undertaken by the community and WOTR's research team.

The third step involved identifying adaptation measures based on vulnerability assessments and incorporating these into the ongoing projects. Lobbying the state authorities on the importance of making watershed projects more climate resilient was also undertaken. The measures included modifying soil and moisture conserving structures to suit changing rainfall patterns and distribution; incorporating biodiversity conservation;[10] integrating vulnerability assessments (main tool described in this chapter) and disaster risk reduction11 activities; and provisioning of weather-based agro-advisories[12] and several climate smart agriculture interventions.[13,14]

Outcomes of community driven vulnerability assessment

This section describes the findings and brief discussion on the application of the CoDriVE-PD tool at two sites.

Profiling study sites

Using GIS-based indicators including landscape heterogeneity, two typologies were identified for CoDriVE-PD application in the Maharashtra site. This site located in Jaffrabad block, Jalna District (Figure 13) spans 14,852 hectares and has a population of 31,122 inhabitants located in 14 villages. It lies in a low rainfall zone (averaging 700 mm per annum) with rainfall recordings of as low as 400 to 450 mm per annum. The area is drought prone. In the Maharashtra site, the two villages representing two typologies reflect the socio-ecological differences in the study sites, particularly in terms of availability of and access to natural resources and infrastructure. Table 5 describes the differences between the two typologies.

Unlike the Maharashtra site, GIS profiling and mapping of villages in the Andhra Pradesh site (case 2) generated a single typology. The sites are in the Atmakur block of Kurnool District. Kurnool District lies in the rainfall-scarce zone in the west-central part of Andhra Pradesh. It is a hot semi-arid ecosystem with rainfall of 700 to 750 mm per year. The watershed comprises five villages and two habitations and covers a total area of 5,364 hectares with a population of 15,628 inhabitants. The Nagarjunasagar Srisailam Tiger Reserve, one of India's largest tiger reserves and a deciduous forest rich in flora and fauna, is in the immediate vicinity of the watershed villages.

Table 5: Characterization of Typology Villages under study in Maharashtra

Parameters	Typology 1	Typology 2
Water sources for irrigation	Greater dependence on wells and inland water bodies	Perennial streams and a river
Vegetation	Higher dependence on local vegetation for livelihoods	Lower dependence on local vegetation for livelihoods
Livestock	Small ruminant rearing was predominant	Large ruminant rearing was predominant
Agriculture	Rainfed agriculture, food crops, low input agriculture	Irrigated agriculture, commercial crops, high input agriculture

Source: Authors

Transect walks and engagement with the community and various stakeholders revealed a picture of diminishing natural resources over a period of 25 years, similar to the case in Maharashtra. These were noted as increased dependence on markets to meet basic needs; increased input costs for agriculture – economic instability caused by crop losses, and limited availability of non-farm livelihood options.

Vulnerability assessments

Over a 25-year timespan, both Maharashtra and Andhra Pradesh sites manifested various vulnerabilities.

In the two typologies in Jalna District, Maharashtra, communities reported weather variations such as delayed onset of monsoons, prolonged dry spells during the season, droughts, sudden heavy rains, hail storms and high summer temperatures. The vagaries of nature and human-induced interventions made them susceptible to shortages of water, fodder and food, and the increased incidences of livestock and crop diseases. Torrential rains caused the loss of infrastructure (homes, bridges and animal shelters). Perennial rivers and wells dried up soon after the monsoon. Few bore wells in the upper catchment region had limited water available year round. Expansion of agriculture led to a loss of common land and increased use of external inputs which raised production costs to 30,000 Indian Rupees per hectare. Crops grown were exclusively commercial (cotton, soya bean, pulses and wheat). Cultivation of food crops (millets) was less than 10 per cent and limited to villages in Typology 1. Typology 2 depended on external sources for food (e.g. public distribution system and local markets) to a greater degree. Flood irrigation was predominant and only 10 per cent of farmers used water-efficient technologies.

Based on the CoDriVE-PD codes arrived at, vulnerability to climate change in both typologies of Maharashtra was high. The code showed that the presence, availability, accessibility and functionality of all the five livelihood capital indicators were either 1: Nil resilience (0-10%) indicating very high vulnerability or 2: Minimum resilience (11-25%) indicating high vulnerability. While the vulnerability indicators in both typology villages were similar, Typology 2 villages were more at risk. Table 6 presents the locale-specific indicators across the five livelihood capitals that assessed the resilience of communities indicating the vulnerability to climate change in the region.

In the Andhra Pradesh site, the CoDriVE-PD tool revealed a differential vulnerability15 across social groups within the main villages and between the main villages and smaller settlements.[16] While the inhabitants of the main villages were mostly from the dominant caste groups, the schedule castes and tribes17 resided in satellite habitations. Caste distribution within the po-

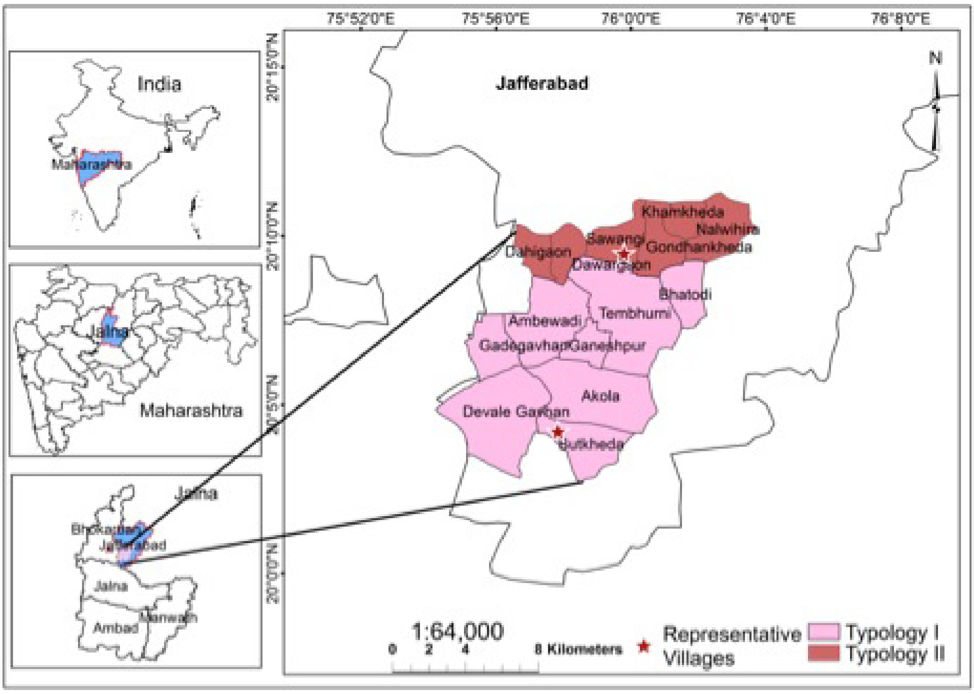

Figure 13: Case Sites 1 & 2: Map indicating the two typologies in the IWMP project in Jaffrabad block, Jalna District, Maharashtra
Source: Authors

pulation was as follows: 29.3per cent: forward caste community members; 21.7 per cent: schedule caste community; 31.5 per cent: backward caste communities; and 17.5 per cent: schedule tribes. Chenchu18, Erukula and Sugali (also called "Banjaras" pastoralists) tribes were predominant.

The main reason for the vulnerability of communities was drought. The consequences of drought included increasing desertification, water scarcity, food production losses (crop, livestock and fisheries), human-wildlife conflict, food shortages and heavy dependence on forest products. Heavy rains caused flash floods, water logging in villages and fields, damage to infrastructure (houses and grain storage infrastructures) and silt deposition in water bodies. Unseasonal rainfall increased pest and disease incidence causing crop losses, particularly at the germination and harvest stages. It also caused animal and human health problems. High temperatures in summer resulted in heat stress in humans and livestock, and crop production losses.

Table 6: Vulnerability status of the five livelihood capitals of the representative villages of Typologies I and II in Maharashtra study site

Asset	Vulnerability indicators	Vulnerability code	
		Typology 1	Typology 2
Financial	• Income earned compared to cost of agriculture production • Quantity of agriculture production • Access to credit • Access to markets • Compensation for crop loss • Crop loan waiver • Availability of non-farm livelihood options	2	1
Human	• Choices based on knowledge, skills and ability related to commercial and food crop farming • Crop diversification • External input agriculture • Use of water efficient technologies and water management • Mechanisation in agriculture • Knowledge of climate change impacts • Skills for alternate livelihoods • Information about subsidies, insurance	2	1
Natural	• Presence of local tree / biodiversity cover • Soil health • Water in river and wells • Extraction of groundwater • Land area under agriculture • Small ruminant farming • Indigenous cattle at household level	2	2
Physical	• Land-based interventions that facilitate conservation of soil and water • Water harvesting structures • Irrigation infrastructure • Bore well and well density • Post harvesting structures • Access to local specific wheat	1	1
Social	• Women's Self-help Groups if existing and its health (functional or dysfunctional) • Village development committee and its functioning	2	1

Note: The Indicators were assessed using the resilience scale to rate vulnerability. Where 1= Nil resilience (0-10%) indicates very high vulnerability (Red: Danger); 2 = Minimum resilience (11-25%) indicates high vulnerability (Orange: Risk); 3 = Low Resilience (26-45%) indicates medium vulnerability (Yellow: Alert); 4 = Medium Resilience (46-70%) indicates low vulnerability (Blue: Stable); 5 = High Resilience (71% and above) indicates very low vulnerability (Green: Safe).
Source: Authors

The level of vulnerabilities across social groups was mainly influenced by societal structures and the capacity to access markets, technologies, healthcare, food and schemes that can benefit them. The vulnerability status and the capacity to adapt to climate change was significantly better among the dominant caste groups over the tribal groups, despite the latter having access to rights over forest resources and tribal development projects. Different levels of asset/capital entitlements including ownership of agricultural assets; access to water resources, credit and government projects; participation in local governance, and knowledge of agriculture and livestock management techniques, caused this differential vulnerability (Table 7).

Large scale landowners had a better financial status and greater access to water from micro-irrigation tanks, crop insurance and debt waiver schemes that helped them continue farming. Smallholder farmers sought wage labour through government programmes, reared/sold livestock, seasonally migrated, took loans or sold property. Communities in the hamlets coped differently. Being hunters and gatherers, the Chenchu moved to the interior of the forest to meet their basic food and other needs, while the Sugali pastoralists migrated with their livestock. In recent times, some marginally took up agriculture, growing small quantities of maize and groundnuts. Others resorted to migration and wage work although they struggled to compete with other communities as their skills were basic. Some of the coping mechanisms used during periods of delayed/unseasonal rains were found to be maladaptive (exploitation of water resources, increasing debts, heavy chemical usage in agriculture, shift to commercial crops), which affected both people and the environment on which they depended.

Differential vulnerability was also identified between the sub-sections of caste groups. In this case the fisher community – a lower sub-caste of the backward caste group who depended on fishing for livelihood – was found to be the most vulnerable group over a 30-year period, despite being a registered body. This was because of the construction of micro-irrigation tanks and other water bodies that prioritized water for agriculture. Dam construction, a non-climatic factor, was the prime destabilizing intervention that affected their livelihood.

In summary, appliction of the tool CoDriVE-PD surfaced similarities and differences in the vulnerability status and the driving factors of the two representative villages in Maharashtra. Though Typology 1 is in the upper catchment, for the financial, natural, human and social capitals, it is rated as highly vulnerable (score 2) while its physical captial is very highly vulnerable (score 1). Typology 2, despite being a lower catchment village with a small river flowing nearby, is far more vulnerable, having scored 1 for all except for the natural capital (score 2). The drivers in Typology 1 are the water bodies that supported ground water availability. The farmers shared the water resources

Table 7: Vulnerability status of livelihood groups in Atmakur Block, Kurnool District, Andhra Pradesh. (L-Large farmers; S- Small Farmerss F- Fisherfolk)

Asset capital	Vulnerability indicator	Vulnerability code		
		L	S	F
Financial	• Credit for agriculture • Crop insurance • Crop and livestock production costs • Quantity of crop production • Fisheries-based loans • Livestock-based allied livelihoods • Funds for village development • Government schemes and programmes	3	1	1
Human	• Crop diversification • Mixed crop farming • Livestock farming • Agriculture - traditional knowledge systems	3	1	1
Natural	• Livestock - knowledge regarding • Traditional inland fishery • Forest - traditional knowledge systems • State of the common property resources • State of the resources of the tropical dry deciduous forest • State of inland lakes and streams • Presence of cultivable wasteland • State of agriculture land and soil health • State of local fish biodiversity	2	2	1
Physical	• Small ruminant rearing • Cattle and buffalo rearing • Feed/fodder resources • Specialized feeds – market based Grain storage facilities (household) • Farm infrastructure (mechanized) • Minor irrigation tanks – access and control • Farm open wells • Farm infrastructure – animal based • Grain storage facilities (public) • Collection points for minor forest produce • Agriculture markets • Farm open wells • Milk collection centres - access • Local weather stations and weather data	4	2	1
Social	• Village/watershed development committee • SHG federation • Forest protection committees • Water user committee • Farmers groups/dairy cooperative societies/informal groups • Sheep and goat breeders' associations • Fisher societies/association • Minor forest produce collectors' association	4	2	2

and some adopted micro-irrigation. Being far from the market, they preferred to grow food crops besides commercial ones and depended on fodder from their farms. Typology 1 village being close to the market opted exclusively for commercial crops and depended on the market for food and fodder. They only followed flood irrigation practices.

In the Maharashtra and Andhra Pradesh sites, expansion of agriculture was market driven, highly chemical and dependent on new crop varieties. In Maharashtra, ground water was exploited. In Andhra Pradesh, water from the dam was diverted for agriculture (controlled by the dominant large scale landowners) which destroyed the livelihood of the marginalized fishing community and the food that fish provided, even though they were traditionally skilled and organized. For food security in the Mahasrahtra site, the marginal communities were dependent on external sources, while in Andhra Pradesh, the tribal people resorted to forest produce.

Between the landholding categories: the large landowners had greater access and ownership to most of the livelihood capitals and better human resources in comparison to smallholder farmers and the fisher community, therefore indicating that the latter two groups are far more vulnerable. The human capital was low for the small holder farmers and the fisher group. The practice of unsustainable crop-livestock production worsened environmental and human vulnerability. However, while the attempt to address developmental gaps, through construction of the dam, favoured agriculturists, particularly large scale landowners as they had more access and control, it negatively affected the fisher community due to the untimely release of water from the dam. This was further aggravated by weather variation. Thus by understanding the systemic interconnectedness between the livelihood resources and the vulnerabilities of the different communities, an appropriate project may be designed.

Integrating CBA options into watershed development

Existing coping mechanisms

Despite the slightly different nature of vulnerabilities faced in both study sites, there were no significant differences in the coping mechanisms employed by both community and government initiatives. Individual households and communities mainly purchased key livelihood assets including food, drinking water and fodder through income obtained from livestock sale. Some farmers resorted to increasing the application of chemical fertilizers to improve productivity. Other practices adopted by certain households included water-efficient practices such as cultivating short duration indigenous crops, and reducing livestock numbers to cope with diminishing feeds. In extreme cases, some households migrated to other areas such as highlands, forested areas where some fodder could be found (see chapter 9 for typologies of CBA).

Additionally, government efforts also supported resilience through seed distribution, crop loss compensation and crop loan waivers. The government constructed soil and water conservation structures as part of employment generation and natural resources management programmes. Processed pulses and grains were made available under the public distribution system.

The coping efforts applied by communities and government broadly met the immediate needs of local communities. However, the efforts left people vulnerable to long-term threats such as increased indebtedness, migration, increased drudgery for women, illnesses which resulted from excessive use of agricultural chemicals and environmental threats such as ground water depletion and deterioration of soil health. Though government initiatives aimed to address vulnerabilities, they seemed to aggravate the bio-physical vulnerability unintentionally through over use of ground water. This highlights the fact that the resource systems in the study sites were interlinked and hence need to be seen as a system. Overexploitation of one resource system will increase the vulnerability of the whole system to climate change in the long run (see Figure 14).

Further, coping efforts were hampered by lack of transparency, accountability and equity in resource use. In most cases, relatively rich large scale land owners compromised local authorities and contravened the water utility rules resulting in overexploitation of community water resources, which threatened fish survival and exposed the fisher folks to climate impacts. As such, while coordination between government officials, farmers and the fisher folk for good management could have helped, caste, weak local institutions, societal dynamics and climate change, exacerbated the vulnerability of the fisher community.

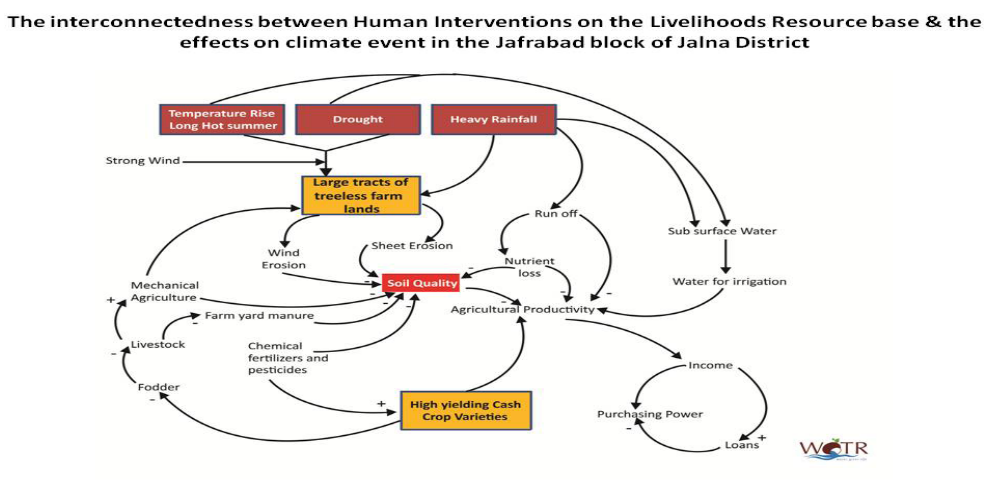

Figure 14: The interconnectedness between human interventions on the livelihood resource base and the effects of climate events in Jaffarabad block

Though both sites had different social and ecological characteristics and natures of vulnerabilities, similar but not always appropriate coping mechanisms were employed. This further justifies the value of applying participatory vulnerability assessment tools, such as the one applied in this study, to understand vulnerabilities and characteristics of communities and accordingly design appropriate and feasible adaptation responses.

Options for building suitable adaptation provisions

Vulnerability assessments conducted using CoDriVE-PD provided various insights into what, where and how appropriate changes may be introduced into IWMP projects to make them climate resilient. Historical information revealed how knowledge systems which existed earlier helped communities manage climate risks, but which have since disappeared because of various externalities, thereby eroding the community's adaptive capacity. As locale-specific weather advisories were not available, the losses varied for various social groups. A deeper look at these details indicates the path to be taken to build the adaptive capacities as well as meet the development deficits of the respective groups in all villages.

As indicated earlier, the CoDriVE-PD is based on systems-thinking principles which help in identifying suitable adaptation options. For example, in Table 7, the Physical Capital shows how the large scale landowners who had water resources accessed water for irrigation and irrigation facilities which contributed to their low vulnerability. The small scale landowners had little or no resource facilities and almost no irrigation facilities, but owned land, which rated them as 2 (highly vulnerable). The fisher folk neither had access to any physical assets for their livelihood, nor control over the water release, which placed them at level 1 (very highly vulnerable). Drawing on their vulnerabilities that require immediate action, the small scale land owners could benefit from adaptation options that include tried and tested interventions. These range from participatory hydrological monitoring, water budgeting, crop planning, precipitation-based soil and moisture conservation, climate-resilient agricultural practices and local specific meteorological advisories for crops, livestock and humans along with alternate non-climate related livelihoods that could be introduced in a systemic manner, thus making watershed development more climate responsive. However, good management of water resources would need to be integrated in building resilience and adaptation for ensuring livelihoods of all communities.

When assessments are repeated, changes in the five capital codes will indicate how vulnerability has been addressed and will thus serve as measures for monitoring and evaluation.

Summary and conclusion

Watershed development in India has helped rehabilitate degraded lands and support the livelihoods and resilience of its inhabitants. However, the increasing demand for land and the pull towards commercial agriculture threaten the longevity and sustainability of WSD. The unsustainable use of the natural resources (soil, water and biodiversity) and poor governance are emerging as major threats. Moreover, superimposed over these is climate variability/change, which further aggravates the existing stresses and neutralizes the beneficial impacts of successful watershed management.

To ensure the success and sustainability of WSD, it is necessary to identify the risks and vulnerabilities arising from biophysical, social, ecological and climatic factors. Unless these vulnerabilities are properly addressed through appropriate climate adaptive interventions, unforeseen and unsustainable impacts emerge during project implementation or later. When typologies are identified within a sub-district in a particular agro-ecologic and climatic sub-zone and CoDriVE-PD is applied to representative villages of these typologies, the results will provide information on the resource base and the various livelihood groups within, as well as the differential vulnerabilities (from climate and externalities) of each. It will also provide the interconnectedness between systems and an understanding of impacts in a holistic manner.

Application of CodriVE-PD at the case study sites provided information for evidence-based programmatic planning. The CoDriVE-PD focuses strongly on community engagement, making the whole exercise and its outputs a 'stakeholder-driven process' immersed in grassroots realities supporting local ownership. The tool usefully integrates climate risks and their impacts, as well as sub-system linkages at the local level and provides a rich picture of the present reality. The sensitivity analysis helps identify the problems and lacunae, where appropriate measures are required for specific social groups, including those that address the needs of communities of both the main village and hamlets. Information on externalities (drivers, pressures) indicates probable barriers to adaptation. It provides a strong basis for project planning, institutional design and capacity building measures to overcome these. Additionally, the dedicated step on inventorying adaptation response or coping mechanisms assists in evaluation and tracking of adaptation and maladaptive practices identified at local levels.

This information, though discussed briefly in the cases above, varies between social groups, which face differential vulnerabilities. The list of locale-specific indicators and the five capital codes obtained by different groups specifies what makes a group vulnerable and how; hence identifies the specific areas that need intervention to build their respective adaptive capacities. This will help programme planners and policy makers at district level and of large scale projects (e.g. IWMP) understand the why and how a region and its inhabitants are vulnerable. It will thus provide directions for designing a holistic approach with locale-specific appropriate interventions to improve the resource base, strengthen communities' adaptive capacities and build the resilience of both.

Although WSD is widely used in dryland ecosystems, the concept continues to be relevant for rejuvenating any type of ecosystem, because all ecosystems are embedded in watersheds. Mainstreaming climate change adaptation using the WSD concept can thus reduce the vulnerability of people and empower them to make informed decisions to cope with current and future climate risks in various types of ecosystems.

However, the key lies in identifying and elucidating vulnerabilities related to biophysical factors, human and ecological issues and climate change risks – to ensure the success and sustainability of any intervention. Participatory community-driven vulnerability assessments help to identify the causes of community and regional vulnerability; the steps required to strengthen resilience and productivity of the resource base; and areas to enhance the community's adaptive capacity. WSD programmes address natural resource regeneration, production systems, and provide farm and non-farm livelihood opportunities. Such programmes have funding streams for capacity building and institutional development. Embedding the vulnerability assessment process into existing WSD frameworks will help identify appropriate interventions that build resilience to climate variability, thus empowering the community to make informed decisions to cope with current and future climate risks.

Notes

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14. http://wotr.org/sites/default/files/Agriculture%20-%20Policy%20Brief%20No.%203.pdf
15. Also termed social vulnerability (the degree to which societies or socially differentiated groups are affected by both internal and external stresses and hazards that negatively affect social cohesion
16. (Shaw and Kristjanson, 2013).
17. The Scheduled Castes (SCs) and Scheduled Tribes (STs) are official designations given to various groups of historically disadvantaged people in India. The terms are r 18.
18. Chenchu: a hunter-gatherer tribe classified as a primitive tribal group by the State government recognized in the Constitution of India and the various groups are designated in one or other of the categories.

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