CoDriVE
VISUAL
INTEGRATOR

Community Driven Vulnerability Evaluation

A Handbook
CoDriVE – Visual Integrator for Climate Change adaptation: Guiding Principles, Steps and Potential for Use

WOTR
water gives life

CoDriVE - Community **Dri**ven **V**ulnerability **E**valuation
Attaining balance through better informed choices

This logo is inspired by the dualism that exists in nature and the need to keep all elements in balance to attain harmony.

The choice of colours-blue and green is symbolic of elements of nature.

Your valuable comments and suggestions on the use of the tool will be beneficial.
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Foreword

India is one of the most vulnerable countries to climate change with its poorest likely to suffer the most. Several factors contribute to this, namely geographical location, low income, limited human and institutional capacities, as also greater reliance on climate-sensitive sectors such as agriculture and forestry for livelihoods. Urgent measures to effectively address the climate risk in development programmes are becoming inevitable. However, the globally available knowledge for effectively conceptualising, designing, planning, and implementing climate adaptation initiatives, especially in development constrained situations, is still quite limited.

The Climate Change Adaptation Project (CCA) implemented in the States of Maharashtra, Andhra Pradesh and Madhya Pradesh by WOTR (Watershed Organisation Trust) and funded and steered by SDC (Swiss Agency for Development and Cooperation) and NABARD (National Bank for Agriculture and Rural Development) has been one of the flagship adaptation projects in the country with interventions in perennially water scarce, drought prone and semi-arid areas. This project has brought out several innovations at various relevant levels. Several participatory tools and methodologies have been designed with the objective to not only engage communities in the assessment of vulnerabilities and climate risks, but also to help design credible and meaningful measures to promote climate resilience in development. One particular tool that serves multiple objectives and functions, is CoDriVE – Visual Integrator (P3DM– Participatory 3 Dimensional Model), a tool developed by a highly experienced, competent and committed team at WOTR, which helps effectively combine traditional knowledge, local experiences and cultural identities together with scientific knowledge and geographic information technologies. I have had the opportunity to observe first hand, the tool being used on the field. What impressed me the most is its ability to build capacities and create ownership within communities. The tool functions as a useful bridge among local communities, policy makers, elected representatives, and development agencies, in appreciating the current situation and developing a consensus on the way forward.

It has been realised that CoDriVE Visual Integrator (P3DM) will be extremely useful in identifying priorities in several thematic areas including sustainable land and water use, crop cultivation, stabilisation and protection of ecosystems, soil and water conservation along watershed lines, addressing biodiversity concerns, appreciating and reducing the impacts of extreme events, most important being the development of a common vision for the whole community.

The development of this geo-referenced and scalable relief model tool has not been an easy process. Inspired by experiments done in the other parts of the world, the tool has been designed, developed and validated in cooperation with the rural communities. One of the most interesting aspects of CoDriVE Visual Integrator (P3DM) is that it can easily be adapted and localised in accordance with specific requirements of the region concerned.

I wish to compliment the WOTR team in coming out with a detailed manual for the use of this important instrument, which should go a long way in facilitating effective design, planning and implementation of measures towards enhancing the adaptive capacities of communities and institutions in fighting climate variability and change. I am confident that the tool is set to travel far and wide and inspire the adaptation community globally.

Message from the Executive Director

Marcella D'Souza
Executive Director

Watershed Organisation Trust (WOTR) has always recognised the value of community empowerment for sustainable rural development. In its Climate Change Adaptation (CCA) programme too, WOTR aims to achieve natural resource security through local governance.

Actively engaging the local inhabitants in planning, implementation, monitoring, adjusting and evaluating projects that are enveloped in complexity, and that face uncertainty and unpredictability such as climate change, need an integrated set of tools. A single tool will not be able to handle these, sometimes conflicting, demands. Hence, WOTR has developed a set of tools strung together, that work to address the varied needs. This is the Community Driven Vulnerability Evaluation (CoDriVE) ensemble. This set of self-contained entities may be used both, as standalone activities or as a series, depending upon one's objectives and resources available. Of this, the "CoDriVE – Visual Integrator (CoDriVE–VI)", is a powerful, participatory integrator designed for communities, local staff, and local governance to come to grips with complexity using 3D modelling as a central theme. It brings the different groups within a village and the decision makers to plan objectively, taking the eco-space and its future required services into account.

Initially, this manual was meant to provide guidelines for the implementation of Climate Change Adaptation (CCA) programme. However, after experimenting with CoDriVE-VI within a Climate Change Adaptation context, we believe this tool can be highly effective for all development projects anywhere.

WOTR is happy to share with you this tool and to join forces in our common endeavour – an empowered action for a sustainable future.

Why this Tool ...

Generally rural communities are left out of development planning as they are considered unable to project their views and needs with a long term vision. Development workers, however, are aware that without the active participation of the local community, sustainability cannot be achieved. Hence, it is best to engage the local inhabitants at the onset, with planning. The gap lies in the ability of the rural inhabitants to communicate their views.

To be fruitful, effective communication between the three main players i.e., the local communities, project facilitators, and relevant governmental bodies is the most important requirement. Each player may seem correct in their respective sphere. However, when seen in the totality of the context, the chips may not add up. These discrepancies and differences may be due to reasons like:

- The information supplied on the social, economic, physical/spatial and ethnic structures in a cluster of villages, may be interpreted differently by the various stakeholders. Given our legendary diversity and existing disparities, interest holders are likely to deduce and respond in ways most suited to current personal interests. At times this may run counter to the interests of other stakeholders, to natural justice, and even future generations.

- Participatory mapping (as in PRA) is a commonly used tool in rural development, for communicating indigenous spatial knowledge. Though these convey local human relationships with the surrounding landscape, they often lack a precise geo-location and/or consistent scaling that makes them useful only for temporary, localised purposes. Hence, PRA is not usually acknowledged by research scientists or governments as "credible" spatial information, due to which rural communities get excluded from decision-making processes. This in turn, has a direct bearing on the development and management of the local landscapes and resources.

Enter "Participatory Three-Dimensional Modelling (P3DM)" – a methodology derived through constructing and demarcating geo-referenced, scaled relief models, that displays indigenous knowledge in a way that is meaningful not only for policymakers and academics but to the communities themselves. P3DM, now adapted and presented as CoDriVE – Visual Integrator (CoDriVE - VI) was conceived in the late 1980s in Thailand.

Having applied this tool in various villages, the experiences have helped WOTR adapt the methodology to bring together, in a visual manner, a complex spatial local scenario. Historical information of 30–50 years earlier, where satellite data may not be available, can now be captured. Of particular importance is its modification for climate change and Disaster Risk Reduction. It has been adapted by WOTR and is now presented as a participatory project integrator, while it may also be used for adjustment, monitoring, and assessment. It is specifically useful for:

1. Communication of indigenous/local spatial knowledge concerning land use, environmental history and cultural identity among local villagers and project facilitators to pinpoint vulnerabilities and refine development objectives.
2. Improved local understanding of climate change with its attendant complexity and in disaster preparedness.
3. Empowerment of local communities particularly the marginalised, and includes natural justice.
4. Enhanced participation by the villages in complex programs, such as a CCA project.
5. Effective transfer of local spatial knowledge to relevant government officials and other development agencies via geographic information technologies.

It is important to mention too, that this is a "work in progress". We believe that CoDriVE-VI is an inherently adaptive tool and we encourage future practitioners to consider specific village needs while following these basic guidelines.

Acknowledgement

This manual is the consequence of experiences gained while implementing “CoDriVE – Visual Integrator” on the ground in various villages in Maharashtra and Madhya Pradesh.

We are thankful to the communities of Akole and Sangamner (Maharashtra), and Narayanganj (Madhya Pradesh) for their active participation in the process and for contributing valuable inputs. Their participation helped us build insights to improve this manual.

We are ever thankful to all the field staff members of WOTR for their valuable assistance in organizing the various events and preparing the villagers for active participation. The CoDrive - VI Core Team wishes to thank all who contributed in their own way to the preparation of this manual.

Special thanks to SDC representatives Janine Kuriger, KR Vishwanathan and Yuka Grieler for their inputs and constant support during the development of this tool and handbook.

Lastly, we thank the SDC and NABARD for their support to WOTR in implementing the Climate Change Adaptation Programme under which innovative tools for climate resilient development have been developed, this being one of them.

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Abbreviations

CBDM	Community-Based Disaster Management
CCA	Climate Change Adaptation
CDVI	CoDriVE – Visual Integrator
DEM	Digital Elevation Models
DRR	Disaster Risk Reduction
GIS	Geographic Information System
GIT	Geographic Information Technologies
GPS	Global Positioning System
IT	Information Technology
NIPAP	National Integrated Protected Areas Programme
NTFP	Non-Timber Forest Product
PBR	People’s Biodiversity Register
PGIS	Participatory GIS
PRA	Participatory Rural Appraisal
P3DM	Participatory Three-Dimensional Modelling
SHG	Self Help Group
WOTR	Watershed Organisation Trust

Contents

1. Introduction: CoDriVE – Visual Integrator for Sustainable Rural Development

When GIS meets Participatory Learning and Action: Participatory GIS

Participatory GIS (PGIS) was conceived in the mid 1990s as an attempt to incorporate emerging GIS technologies into international development initiatives by involving stakeholder communities to map local processes and environmental decision-making. PGIS transcends the limitations of earlier Participatory Learning and Action[1] methods for community mapping (such as sketch maps) with an increased sensitivity towards technology by using the same as employed by governments and academic researchers for resource management. In contrast to earlier efforts, PGIS uses GIS to produce maps based on stakeholder perspectives of their environment, which include socio-cultural and behavioural elements of human landscapes that are often ignored in governmental or research-based GIS analyses. PGIS is anchored on the assumption

[1] Participatory Learning and Action (PLA) is an overarching term for various approaches to international development from the grassroots level, which seek to empower local communities with maximal ownership over development goals by encouraging stakeholder participation. Many of these methods are documented and available online by the International Institute for the Environment and Development (IIED).

that the creation of digital, geo-referenced maps by marginalised communities (such as rural indigenous peoples in developing countries who have been historically excluded from environmental decision-making) encourages the recognition of local, indigenous knowledge by governmental bodies and research institutions as being credible forms of spatial information. Access to GIS technology, according to PGIS practitioners, allows marginalised communities to effectively voice their development concerns across a wide geographic extent and at local, regional, national, and international levels for the purposes of awareness-raising, advocacy and collaboration among interest groups.

However, several well-documented challenges arise when a highly expensive, complex technology such as GIS is introduced to indigenous communities in developing countries. The most prominent one is of governance. If the goal of a PGIS initiative is to establish complete community ownership over a map and its contents, the stakeholder community must have full control over 1) data collection and ownership, 2) establishment of the map legend (i.e. decision-making concerning the maps contents), and 3) data processing and map production. The implication here is that stakeholder communities must learn how to implement GPS and GIS independently and sustainably. This has worked well in the Western contexts where communities generally have an understanding of cartographic principles and easy access to technology. For isolated, rural communities in developing countries who are not proficient in English and have never been introduced to technology, complete stakeholder governance of PGIS is virtually impossible. Many PGIS initiatives for rural indigenous communities therefore employ external GIS practitioners to collect relevant spatial data from stakeholder communities then process and finalise the output outside of the community. While GIS has the ability to store and display large amounts of high-resolution spatial data, the software, though unintentionally, facilitates manipulation of such data by the user. Without a system of complete accountability for adequately expressing indigenous perspectives in digital form, the PGIS initiatives can end up emulating the predominantly top-down management models they were designed to neutralise. The misinterpretation or misuse of such knowledge, should it fall into the wrong hands, can lead to intentional or unintentional exploitation of indigenous communities or their environments. There seems to be a lesser degree of community empowerment and a greater possibility of continued community marginalisation when the spatial data and resulting map do not remain under stakeholder control, and for this reason many PGIS projects in developing countries are criticised for not being as "participatory" as they should be.

2. TOOL: Development and Design

CoDriVE – Visual Integrator is a community mapping tool that combines indigenous spatial knowledge with topographical and other geophysical information to produce a scaled-relief model of the local domain. The process requires a minimum of 3 days, in a workshop-fashion, amongst a group of representative participants from the indigenous community and several external facilitators. The group assembles around a common purpose pertaining to the local environment to which CDVI will contribute. Then, using enlarged topographic maps of the local area, participants construct the model by superimposing layers of corrugated cardboard – each traced from a single topographic contour line – and demarcating the model with relevant spatial features stored in the community psyche. The complete model can be transposed into GIS via manual tracing techniques or digital photography, thus producing a digital, geo-referenced map that can be used for collaboration with governmental bodies and research institutions. The model itself thus remains with the community for internal use and future modification.

Since its origins in Southeast Asia in the late 1980s, P3DM (which has been adapted to CDVI by WOTR) has emerged as an effective tool for indigenous community-based resource conservation and planning, territorial conflict mediation, and disaster risk reduction, among other uses pertaining to land and natural resources in developing countries[2]. It has also presented itself as an excellent alternative to previous PGIS methods, in that CDVI inherently places relevant spatial data under the complete control of stakeholders, reduces the risk of data corruption, and reveals geographic information and indigenous spatial knowledge in forms that are accessible to both stakeholder communities and policymakers.

Rather than depending exclusively on GIS technologies and abstract maps, CDVI employs a precisely scaled, physically and mentally tangible model using locally available materials. Participants control the spatial data displayed on the model by establishing a consistent legend using various colours of pins, yarn, and paint for points, lines, and polygons[3]. In a typical PGIS process, these features would be inserted digitally into a map from GPS data, which is less intuitive and less participatory. It can therefore be assumed that the resulting map was less meaningful to those who provided the spatial

Potential Benefits of CoDriVE – Visual Integrator for Indigenous Peoples

- Enhanced visual recognition of important spatial features and boundaries
- Improved understanding of ecological complexities, vulnerabilities, and the consequences of human behaviour on the landscape
- Community cohesion and collaboration over indigenous perceptions, needs and concerns a collective space of knowledge-sharing
- Increased self-esteem and motivation amongst stakeholders to participate in development interventions
- Effective communication of indigenous knowledge, development needs, and planning strategies amongst indigenous communities, NGOs, government bodies, academic researchers, and international development agencies

2. A comprehensive list of P3DM applications, case-studies, handbooks, and other PGIS publications can be freely accessed at www.iapad.org, a not-for-profit venture of Participatory Avenues.

3. Points, lines, and polygons are the forms by which spatial features are logically presented in GIS. Points represent discrete locations, like village dwellings or wells, lines represent single continuous features, such as rivers and boundary lines, and polygons represent features with larger areal extents, such as forests and reservoirs.

data. By contrast, CDVI engages participants in the mapping practice from start to finish; from the construction of the base model to the digitisation of the complete demarcated model. Establishing complete control of the model and its legend by a group of community members rather than a single or few GPS /GIS users engenders a sense of community ownership that is an important motivator in expanding participation in environmental decision-making processes. Indigenous communities may not be able to take part in the full GIS digitisation of the model for the same reasons mentioned earlier. However, this becomes less of a concern in CDVI because the points, lines, and polygons reflecting collective indigenous knowledge are already secured in the model by the participants. The risk for data corruption or misinterpretation is therefore significantly less than if the data was collected and processed by one or a few external GIS experts.

Also significant are the distinctive cognitive processes that occur within indigenous communities when working with a three-dimensional model as opposed to a two-dimensional map. The addition of a precise and consistent vertical scale to a map is unique to CDVI and can greatly enhance spatial recognition by indigenous communities because spatial knowledge is three-dimensional rather than two-dimensional. Landmarks are easily identified when observers can visualise the terrain. Once participants can precisely locate themselves, they can then move towards identifying other important features that pertain to their relationship with the environment. Thus the physical tangibility of CDVI increases the accessibility of indigenous spatial knowledge[4].

CoDriVE – Visual Integrator emphasizes the means as much as the ends. While other PGIS

Applications of P3DM across the Global South

- Protected Areas Management (Philippines)
- Watershed Management (Philippines)
- Securement of Legal Right to Resources (Ecuador)
- Ancestral Heritage and Cultural Sustainability (Philippines, India, Uganda, Fiji)
- Territorial Conflict Resolution(Philippines)
- Disaster Risk Reduction
- Community Forestry (Nepal)
- Participatory Land Use Planning (Thailand, Nepal, Ghana, Ethiopia, Kenya, Sri Lanka, India, Honduras)
- Education and Communication (Nepal, Morocco, Guatemala, Philippines)
- Collaborative Research (Thailand, Vietnam, Philippines, Colombia)
- Climate Change Adaptation (Papua New Guinea, Philippines, Solomon Islands)

These examples have been gathered from www.iapad.org, an official website of P3DM, PGIS and other Participatory Mapping documentation. See this website for details.

4. Rambaldi, G. 2010. Participatory 3-Dimensional Modelling: Guiding Principles and Applications, 2010 edition. CTA, Wageningen, the Netherlands, p.6

initiatives have focussed largely on the resulting maps; many advantages of CDVI lie in the process of constructing and demarcating the model. The construction of a three-dimensional model from a two-dimensional topographic map is both a labor- and time-intensive endeavour, but in this time, participants engage together in a critical space of collective learning and knowledge-exchange. Older generations may share stories with younger generations. Men and women discuss and compare their distinct relationships with the land, and critical environmental concerns and vulnerabilities are allowed to freely emerge[5]. It would be incorrect to assume that the cognitive spatial perspectives of each individual participant are identical, and sometimes this process may lead to disagreement and require compromise amongst participants, which in itself is a vehicle for indigenous spatial knowledge verification. By engaging participants in a space of hands-on discovery learning[6], CDVI further lends itself to enhanced community collaboration and participation in environmental decision-making.

3. Sustainable Rural Development Needs Climate Change Adaptation

Few can deny that the natural, social, political, and economic climate of the world is changing. Environmental degradation, caused by global overconsumption, dismantles food, health, and livelihood security, and affects foremost the millions of people across the world that depend on locally available resources for survival. The long-term consequences of these changes being uncertain, there is little choice for these communities but to minimise their vulnerability to change, while maximising resilience.

Climate Change Adaptation: Project Components

- Watershed Development
- Adaptive Sustainable Agriculture
- Agro-Meteorology
- Water Budgeting
- Biodiversity & Ecosystem Services
- Disaster Risk Reduction
- Sustainable Livelihoods & Localisation
- Alternate Energy

Following the implementation of natural resources regeneration and watershed development projects, the expectation is that the soil and water conservation would increase agricultural productivity and ensure water availability. However, drought, floods and unseasonal or extreme weather variations affect the desired impacts. Therefore, factoring climate change and adapting to it is essential. This initiative attempts to combine technical strategies with educational and capacity-building methods that provide communities with maximal ownership over their own development plans to alleviate poverty. The approach to CCA

5. Rambaldi, G., Callosa-Tarr, J. 2000. Manual on Participatory Modelling for Natural Resource Management. Essentials of Protected Area Management in the Philippines, Vol. 7. NIPAP, PAWB-DENR, Philippines.

6. Rambaldi, G. Participatory 3-Dimensional Modelling: Guiding Principles and Applications, 2010 edition. CTA, Wageningen, the Netherlands.

is systemic in nature – it comprises of a variety of elemental, interconnected development processes that commonly aim at improving a community's overall ability and incentive to adapt to change – be it environmental, political, or economic. Therefore, much of the work of CCA focusses on technical and awareness-building endeavours that seek to 1) enhance community awareness so that lifestyle behaviour sustains and benefits local ecosystem resources and 2) provide communities with the necessary tools and support to develop plans for more independent, community-based governance initiatives pertaining to overall development goals.

The role of field staff when implementing a CCA project is to provide practical guidance during project implementation and enhance community awareness surrounding the vast complexities of climate change and ecosystem dynamics. However, the principle body of knowledge that should appraise any CCA project must be the village communities themselves. Indigenous communities, as mentioned earlier, have a wealth of stored knowledge in their collective histories that has been adjusted and refined over hundreds of years and many generations of experience. Without the active participation of stakeholder communities and the acknowledgement and incorporation of this knowledge into development plans, any CCA initiative will undoubtedly fail. The need for capacity-building and educational tools for CCA, which address the complexities of human-environmental relationships while simultaneously placing indigenous knowledge at the forefront of project goals, is therefore paramount.

4. Applications of CDVI for Climate Change Adaptation

The following sections are brief descriptions of specific potential applications of CDVI in Climate Change Adaptation.

Disaster risk reduction

Disaster Risk Reduction (DRR), as a concept, represents the overall purpose of Climate Change Adaptation, as the overall objective is to prepare communities to respond to potentially disastrous changes. As an element of CCA, DRR focuses on providing communities with the necessary tools and resources to bolster their resilience to disasters while simultaneously minimising their vulnerability. The primary objective of DRR is to instigate a Community-Based Disaster Management (CBDM) plan, wherein village communities first identify disasters to which the community is vulnerable and the factors contributing to such vulnerability. The community then takes steps to address these factors while building a response plan for use in the case of disaster.

This element of CCA possesses a large spatial component, as some vulnerability tends to be physical. However, besides aspects related to CC, at times communities point out to physical aspects that they consider hazardous. For example, village Khadki Budruk indicates that the electric poles around the village frequently emit sparks, threatening the possibilities of fire hazards around the settlement. The identification of physical hazards is an important initial step in the CBDM process, and a large-scale CDVI can be of great aid here. On CDVI maps at 1:5,000 scale or larger, village infrastructure can be identified. On such a model, participants can demarcate physical "hazard hotspots" and "population hotspots" – any landscape feature which increases the risk of a particular disaster. Once physical hazards are identified on the model, the path has been cleared for discussion of less tangible hazards, which are more conditional than physical. For example, landslides were a common hazard within Shiswad village. On a CDVI, participants can demarcate landslide-prone "zones", which one should avoid or take precautions when nearby, especially during the rainy season. Bringing a community together over the CDVI process, where old and young, men and women can collaborate together, is of great value in the CBDM initiative, because the information is clearly communicated and spread throughout the entire village in the form of a tangible, three-dimensional model. By making information tangible and localised, villagers exhibit a more thorough understanding of complex issues, and are better capacitated to make significant positive changes to increase community resilience.

A digitised CDVI poses further substantial benefits to DRR by effectively communicating regional vulnerabilities to government agencies. If presented and communicated in an "official" format, relevant government administrators may ideally be more willing to listen and respond to institutional needs pertaining to the reduction of disaster risk for remote, rural villages.

Education and Capacity Building

It is often difficult to visualise and comprehend changes that happen over generations. Human behavioural impacts on ecosystems are slow, complex and interrelated, but an understanding of these are crucial, if there is any possibility of reversing loss of biodiversity and environmental degradation. As a part of CCA, it helps to educate village communities on these issues, with the hope of building awareness to detrimental behaviours that perpetuate poverty.

CDVI aids in these educational strategies because it brings these difficult concepts to the local landscape. In the model construction process, participants literally watch their homelands appear before their eyes. They can visualise and articulate how the landscape has changed over generations. Bringing these complex notions into a local context is extremely valuable for communities with very little formal education or contact with other types of landscapes. CDVI is an educational tool that speaks in the universal language of space, which is accessible not only by adults, but also by children. As the capacity of village children to adapt to climate change represents the future of these villages, CDVI therefore makes a powerful educational tool in inducing behavioural change.

Watershed Development

Reliable ecosystem services are essential for maintaining village health and economic security. Therefore, practices which regenerate degraded ecosystems and aquifers are at the crux of Watershed Development for CCA. However, it is absolutely vital for the sustainability of these ecosystem services that as much input and decision-making power as possible comes from within the village communities themselves. CDVI can enhance public participation in Watershed Development plans by providing a visual representation of the planned infrastructure related to a Watershed Development. This may involve continuous contour trenches, areas for which grazing may be banned to allow forest regeneration, or the locations of agro-met stations. Watershed planners and agro-meteorologists can work together around a CDVI model that can be adjusted and ratified should the need arise, keeping the entire village informed of its progress.

Sustainable Agriculture[7]

Establishing practices for a more sustainable agriculture will contribute largely to securing local soil and water resources. It lowers the overall cost of agriculture while maintaining yield, meaning that sustainable agriculture bolsters the economic security of rural villages. CDVI can be used in sustainable agriculture initiatives as a planning tool. Village communities can plan in various ways, some being: identifying fields which should lie fallow, crop rotations, and companion planting. Again, the CDVI model can be amended on the basis of need, keeping the entire community up-to-date with current plans and objectives.

Biodiversity & Ecosystem Services

Biodiversity loss is a major contributing factor to resource scarcity. Common mono-cropping practices diminish soil nutrients, and deforestation destabilises top soil and destroys critical habitats. Without a common understanding of human-behaviour/environment relationships, it is difficult for villages to understand the importance of issues for example, bans on grazing. Sustainable management of natural resources should go hand-in-hand with ecosystem stewardship. It is necessary to emphasise the importance of biodiversity, with the hope of encouraging villagers to recognise the inherent value of healthy ecosystems and incorporate this value into everyday behavioural choices. One mechanism, the People's Biodiversity Register (PBR), a tool recently developed, is currently being used for capacity-building, by which village communities gather local plant specimens, record, and assess their local factors of biodiversity. The hope is that village communities can develop a conservationist mentality with regards to their local ecosystems.

CDVI greatly enhances PBR because of its localised, interactive nature. Participants can demarcate "biodiversity hotspots" and fragile eco-zones. The entire PBR initiative can be mapped spatially, thus, communicating this information and creating awareness throughout the entire village.

Community Based Eco-Tourism

Eco-tourism is a more distantly-related component of CCA than others. While it may have little impact on the natural resource-base of village communities, it certainly has an impact financially. Eco-tourism provides visitors with an experience of rural Indian culture by exposing them to the realities of everyday village life. The desired outcome is that visitors become aware of how rural people live, the challenges they may face, and the impact their urban lifestyles and daily choices may have on rural communities. In turn, eco-tourism provides a community income, which bolsters the local economy and provides an alternative livelihood option to agriculture.

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7. P3DM has been used by the North Eastern Region Community Resource Management (NERCRM) project for sustainable agriculture initiatives in the village of Sasatgre, in the West Garo Hills of Northeastern India. For details see the following: http://ictupdate.cta.int/Feature-Articles/P3DM-Mapping-for-sustainable-agriculture. Project supported by the International Fund for Agricultural Development (IFAD).

Complete CDVI models are interactive and interesting to view. They highlight spatial information that is considered valuable to the local community, and are therefore informative and meaningful to visitors. A CDVI can portray popular vistas, provide suggestions for tourism, and suggest places of cultural significance. Having been built by the community itself, a CDVI can be a source of village pride and community cohesion, which is important in successful eco-tourism. These models, once constructed and demarcated, continue their being useful not only as internal planning tools for education development but also as a way to build awareness amongst external parties. CDVI models should therefore be kept in a conspicuous place in the village maintained by the village itself for maximum continued awareness-raising benefits.

5. Method Overview

P3DM has been used and heavily documented since the late 1980s across the Global South. Today there are detailed handbooks freely available online[8], and one can be found in section 7. this manual. It is highly recommended that future practitioners read this supplemental manual[5], as important details provided there are not present in this general overview. However, several modification have been made by WOTR to P3DM, now called CDVI. These are outlined here. Detailed instructions and a supply list can be found in the A Step-by-step guide to CDVI Implementation (Section 7).

Project Planning

CDVI requires significant planning by facilitators prior to engagement with local communities. The intended purposes of the CDVI model must be clearly stated and strictly followed throughout the process. This is necessary because 1) the intended purposes of the model will determine supplies purchased, and 2) due to the time commitments to CDVI, a continually reinforced and communicated purpose reduces confusion amongst participants and guides progress. To establish and maintain the specific objectives for CDVI, in any case several decisions must be made and tasks completed before any other steps are taken.

1. **Declaring the Purpose:** CDVI is a highly adaptable tool that has many uses related to rural development. However, the specific purposes of any given CDVI project should be stated clearly and posted in a visible place throughout the entire process, to keep both participants and facilitators on task.

2. **Determining Scale:** The scale[9] of the model will determine the features to be displayed.

[8] See www.iapad.org

[9] http://www.iapad.org/publications/ppgis/p3dm_nipap.pdf

Large scale maps (scale 1:5,000 or higher) will be able to show buildings, bridges, and other infrastructure relevant to DRR. By contrast, small scale maps (1:10,000 or higher) are best suited for dealing with large areas, as is necessary in Watershed Development and Biodiversity. While many benefits of CDVI do not depend on scale, the map's scale will determine the overall scope of the project, and is therefore an important part of the planning process. It should be noted that the vertical scale depends on the thickness of the corrugated cardboards that are locally available.

3. **Determining Size:** The scope of a CDVI initiative depends also on model size. If meant for public awareness, larger maps are better. Where the intended purpose is planning only, a smaller model will suffice. The scope of the initiative should be decided prior to procuring necessary materials.

4. **Training and Preparing Facilitators:** The positive outcome of CDVI is heavily dependent on the reliability, transparency, and commitment of CDVI facilitators and it is thus mandatory that facilitators have a thorough understanding of CDVI and are prepared to guide participants through the process using clear communication. Ideally, facilitators should have some prior familiarity with the village and its inhabitants with an understanding of the local socio-political situation.

Procuring Material and Associated Secondary Data[10]

The next step in the CDVI process is the procurement of necessary material. This step highlights the importance of the initial planning decisions discussed above, because these decisions determine types and amount of supplies needed. The supply list for various applications of CDVI will vary, but generally the material may be grouped for the various stages of CDVI. In other words, certain material will be necessary for 1) constructing the base model and 2) demarcating the base model, and 3) digitising a complete model into GIS (if this step is included). A general supplies list can be found in the appendix to this manual.

CDVI relies on the availability of topographic data on the area of interest. For adjusting the scale to specific needs, it will be necessary that this data be digital. Having digital baseline data also facilitates accurate demarcation as well as model digitisation. Standard reference contour intervals are 20 m, although 10 m contours may be more ideal. This will depend on the chosen map scale. Once size, scale, and contour interval are determined, 2-D topographic maps must be extracted from DEMs or scanned toposheets, and printed to the exact size of the planned CDVI model for tracing and cutting the cardboard contour layers.

Organising Participants and the Construction Venue

Prior to beginning the model construction, it is necessary that the participants be organised and informed about CDVI and the intentions behind implementing it in their village. Participants should volunteer of their own accord and the group should ideally consist of men and women as well as elders and young children, to enhance community cohesion and establish a truly representative body of the stakeholder village. If village leaders and village affiliated

10. See the attached Manual on Participatory 3D Modelling for Natural Resource Management (Rambaldi and Callosa), p.9 for details on materials procurement.

representatives (such as self-help groups, community based organizations, etc) are not involved in the CDVI constituency, they should be at least included in the initial introductory CDVI sessions. It is also important to make the entire process open to whoever within the village community would like to observe the process.

Other P3DM projects have divided participants into several groups based on functionality. Facilitators have used local students and teachers for the initial construction of the model[11] and then relied more heavily on elders who retain valuable spatial knowledge, in the demarcation process. In the CDVI method described here, the participants have been included in all stages of the process (though specific tasks are divided among small groups for efficiency – participants can then exchange tasks after some time). However, the precise protocol for this should best fit the purposes of the specific application of CDVI.

The venue will also have to be predetermined – this must be centrally located within the village and spacious enough to accommodate roughly 25 people and various simultaneous (modelling) activities. Being located centrally in the village maximises exposure to the entire community.

Constructing the Base Model

The following outlines a basic step-by-step approach to construct the base CDVI model. As mentioned earlier, more details are included in 'A Step-by-Step Guide to CDVI Implementation' (section 7). Photographs can be found in the attached Manual on Participatory 3D Modelling for Natural Resource Management by G. Rambaldi and J. Callosa-Tarr for the NIPAP/PAWB-DENR, Philippines (beginning on page 10).

1. A layer of carbon paper is taped to the bottom of the reference base map (topographic), with the marking side facing out.

2. Corrugated cardboard sheets are prepared of exactly the same size as the reference base map.

3. On each sheet of cardboard, a single contour is traced, using the base map with carbon paper underneath as a reference. Sheets are labeled with the contour elevation and a north-pointing arrow, for proper orientation.

4. Contours are cut from the cardboard sheets[12].

5. Contour sheets are superimposed on one another in the correct order and precise orientation[13] and then pasted together.

6. Once dry and secure, the model is covered with a thin paper, pasted using acrylic white or translucent gel medium. This paper smoothes out the contour layers and helps with terrain continuity.

7. Meanwhile, a table is custom-built to the exact size of the model, for the purposes of public accessibility and display. The base model is then mounted on the table. Instead of constructing custom tables, plywood sheets may be used for working on and displaying the model.

11. See Manual on P3DM for Natural Resource Management, page 5.

12. Note: In WOTR's full trial of CDVI for Partala, Madhya Pradesh, steps 1–4 were completed in the Pune office before engaging with village participants. Due to the lack of time, this was an ideal option in this case. However, it should be noted that ideally participants, even if only a small group of them, should be included in the entire construction process.

13. This method has been modified by WOTR.

Model Demarcation

Next, participants engage in a consultative process that leads to the model's demarcation. Over the complete base model, participants orient themselves and discuss landscape features, valuable ecosystem resources, culturally or socially significant areas, and if they so desire, also share local historical events. Being a delicate, collaborative stage, it should be given plenty of time for dialogue. Facilitators should be prepared for possible social inequities to arise or ongoing social or political conflicts that may be simultaneously occurring in the village. Participants may argue over the precise location of a particular feature. These conflicts should be allowed as they bring forth community vulnerabilities and specific development-related concerns. The facilitators must strike a balance between allowing a conflict to emerge and acting as a mediator to diffuse a situation, where it so arises.

Before anyone marks on the model, the participants must determine the legend with the assistance of CDVI facilitators. It is unconditionally imperative that the participants have as much control over the decision-making pertaining to feature-coding on the map as possible, with practical guidance from CDVI facilitators. General guidelines for legend-making can be found within the more detailed instructions located in section 7 of this document.

Once the legend is created, participants can then begin demarcating boundaries and relevant point, line, and areal (polygon) features. It is recommended that participants mark with pencil or light pen, until a particular feature is precisely located and agreed upon. This process will also take significant time, and great care should be taken by facilitators that the process is organised, features are clearly identifiable, and the model maintains complete consistency with the legend.

Depending on the intended objectives of a CDVI project, several key discussions related to environmental decision-making may take place throughout this process. For example, if the model is intended for Watershed Development purposes, discussion of land-regeneration and water restoration schemes must be decided upon at this stage. As another example, if the model is intended for Sustainable Agriculture, this session may need to be supplemented with education on crop rotations and drip irrigation prospects. The entire CDVI process must be placed in the context of its ultimate objectives, which should be continually reinforced by participants and facilitators.

Transposing CoDriVE – Visual Integrator into Geographic Information Systems

A great benefit of CDVI is that the spatial information comes directly from the stakeholder communities, while it is also communicable with relevant external agencies via GIS. However, it is found that this process is not necessary to derive the benefits of CDVI in participatory environmental decision-making and education at the village level. Models should be digitized when it is decided that the information stored in a participatory 3D model would be of aid at research and policy levels. However, the establishment of a permanent model in the village for internal planning and community use alone justifies model creation.

Digitisation occurs after the model is completely demarcated and has been officially handed over to the community at large. This process should be reserved for GIS technicians who have an understanding of the extraction process and have been thoroughly informed of the model's contents and legend (if they did not take part in the construction process). In the NIPAP initiative in the Philippines, GIS practitioners used plastic sheeting and superimposed reference grids to trace all spatial features, which were then scanned and geo-referenced in a GIS. It is essential for this process that the spatial features be marked by points, lines, and polygons as these represent all spatial data in GIS. This process should be carried out systematically with a high degree of accuracy to minimise errors when geo-referencing the data in GIS. Facilitators must be careful to ensure that the information to be digitised is properly categorised and documented in detail, to avoid confusion amongst GIS practitioners. There is also a possibility of using digital cameras to produce images of models that can be uploaded into a GIS. However, great care must be taken in taking the digital photographs, as any pitch or tilt in the camera angle will distort the image. Also, one must calculate the precise relative height of the camera lens to account for scale in GIS. While seemingly more convenient, this method poses a greater risk for spatial inaccuracies.

While one may not digitise a 3D model, having a standard digitisation protocol developed that systematically includes CDVI, would greatly facilitate CCA communication among all stakeholders, and will establish GIS practices within the organization.

6. Good Practices in Participatory Mapping: Notes for Facilitators

It is important to remember that CDVI is not a solution – it is only a tool. While CDVI poses significant potential benefits to CCA, the realisation of these benefits will depend largely on how well the tool is implemented by the field staff and received by village communities and relevant external agencies. Therefore, sensitisation to well-established guidelines for CDVI practitioners is essential.

Three Ts

Successful application of CDVI for CCA will mandate conscious efforts towards providing a positive, enabling environment throughout the entire process. CDVI construction and demarcation naturally lends itself to collective knowledge sharing amongst participants, but a positive impetus for this must also come from facilitators. Participatory mappers from around the world[14] have presented three essential elements in maintaining an enabling environment for CDVI participants, which they call the "Three Ts".

Transparency: To be transparent is to communicate clearly and honestly, without withholding any information from stakeholder communities. Potential shortcomings and future commitments associated with the CDVI work

14. Corbett et al., Overview: Mapping for Change: the Emergence of a New Practice. Mapping for Change: Practice, Technologies, and Communication. Participatory Learning and Action, No. 54, April 2006.

may arise in the process, and these should be communicated to all participants. Transparency requires that facilitators and GIS users are openly held accountable for their actions by participants. It may not be possible for the entire village to play an active role in the CDVI process, but facilitators should do everything they can to ensure that meetings are at least open to everyone.

Time: Time constraints imposed by facilitators to push through external agendas place a detrimental pressure on the CDVI process. It should be acknowledged that to create a space in which village participants are comfortable sharing traditional knowledge takes time: time to build relationships between facilitators and participants, time for participants to understand the CDVI process, and time for the intended outcomes of CDVI to emerge. Time may be one of the largest commitments required by CDVI, but it is also essential to allow the process to unfold in as much time as it may take.

Trust: Trust is the essential ingredient that allows participants to communicate freely amongst themselves and amongst CDVI facilitators. Without open communication, CDVI immediately loses its value in reflecting true indigenous perspectives. CDVI reveals potentially fragile information concerning local culture, tradition, and natural resources, which requires a large degree of trust amongst all present throughout the process. Accomplished CDVI facilitators take time to build relationships with participants before, during, and after model construction.

Consistency and Accuracy

It is not always compulsory that a CoDriVE – Visual Integrator is spatially absolutely accurate. Again, the construction and demarcation processes themselves are at the heart of the tool's value because it is these processes that engage communities in participatory decision-making and enhance community cohesion. The model intends, above all, to provide relevant information and raise awareness amongst village communities. However, great attention must be paid to accuracy if the model is to be digitised, because only this accuracy makes indigenous knowledge credible at research and policy levels. Therefore, in the case of construction and digitisation facilitators must take great (and possibly painstaking) care to guide CDVI so that spatial accuracy is maintained.

While accuracy is not always a concern, facilitators must try and uphold consistency with the initial goals of CDVI throughout the process. Last-minute changes create confusion and can dissolve model relevance and participant motivation. Strict consistency with regards to the legend is also a must. Changes might prove necessary for the legend; however it is advisable that these be minimised to avoid confusion and maintain the model's visual aesthetic nature.

Keeping a Larger Perspective

It may be easy to get caught up in the details of the CDVI process, but facilitators should keep in mind the larger perspective – the overall goals that CDVI and CCA seek to accomplish. The reason participatory methods are effective for development is because they raise community awareness and motivation to invest time, physical effort, and sometimes financial resources to their own development initiatives. The hope is that better awareness and better governance will lead to better behaviour – behaviour that sustains livelihoods and local ecosystem health. Therefore it is essential to engage in participatory methods for Climate Change Adaptation.

However, it is important to note that local socio-political hierarchies sometimes cause participatory methods to become tools of power in the hands of those "in charge". If better governance and awareness does in fact lead to better behaviour, facilitators must pay attention to any social inequities that might arise and take measures to minimise them so that all voices are heard. It is important to learn that indigenous knowledge from a local community is not one voice; it is many and facilitators should make it a point to ensure that CDVI reflects a collaboration of village perspectives.

A Word on Ethics

It is important to note the sensitivity of indigenous spatial knowledge when conducting any participatory mapping initiative. The Information transposed on a CDVI holds great significance to the people who supplied it, and care should be taken so that such information remains in responsible hands. Throughout centuries, maps have been used as tools for exploitation of the powerless by the powerful. In certain cases, the release of spatial information concerning natural resources, for example, runs a risk of allowing others to use it exploitatively. At the start of any CDVI workshop, facilitators and participants should therefore design the project together in a communicative space where all must be transparent in their intentions on creating the model (i.e. how the geographic information will be used, if transposed into GIS).

Important Requirements for the Effective Use of CDVI

As CDVI presents an opportunity with potential, there are important aspects to be addressed to make it effective.

A Common Platform

CDVI is a significant and useful tool that can greatly reduce the technological, social, and political gaps between those who implement resource legislation and those who directly use the resources. To bring village communities into resource management dialogue through high-resolution digital maps would be a requirement. However, to use CDVI to this end would require tight communication and collaboration amongst all related parties.
A close relationship with the relevant government agencies would greatly facilitate knowledge transfer. Within an implementing institution it would require a closer relationship between the Capacity Building and IT Teams to successfully digitise a CDVI.
In order to reap the digital benefits of CDVI, these two teams must collaborate to produce a standard digitisation protocol by which the indigenous knowledge represented on a CDVI can be geo-referenced and accurately demarcated in the field, and transferred to the office for digitisation.

The Relevance of Sufficient Time

CDVI is not just "an activity" for collecting visual information. Rather it is a tool that delivers various related outcomes. It motivates and mobilizes all stakeholders within a community towards a common agenda. It collects historical facts; captures the current situation; highlights priorities of the primary stakeholders (the villagers) and helps planners (government and development agencies) design intervention locations where they are required. Hence to best obtain the multifarious outcomes of its application, CDVI would need to be allocated sufficient time. Together with "TIME',it is also necessary to get the required team in place, so as to get the best results.

CDVI can be employed easily on a limited budget using locally available material. But, to grasp its full potential, time is required to organise participants and material, initial instruction and orienting, model construction and demarcation. All these are possible only after a thorough dialogue amongst participants, and model digitisation. Given an institute's multifarious commitments throughout CCA, time and manpower will be the important determinants to CDVI implementation. A possible solution to this would be to propose an internship opportunity for a CDVI coordinator. Under the Capacity-Building Team, this position would involve scheduling workshops, organising field teams and transport, procuring supplies, reporting, and training. If enough time is spent with this manual and associated CDVI documentation, a single internship would ameliorate many of these challenges, and help secure CDVI as a core tool within an implementing organization.

7. A Step-by-Step Guide to CDVI Implementation

This section is a basic step-by-step guide to using CoDriVE-Visual Integrator (CDVI). It covers steps from model preparation through construction and demarcation. The method is adapted from the Manual on Participatory 3D Modelling for Natural Resource Management (Rambaldi, Callosa-Tarr 2000).

I. Model Design and Preparation

Crucial details must be determined at the beginning of any CDVI initiative. These decisions drive the model's progress and determine the types and amounts of necessary material. Planning decisions concerning the following are essential:

1. **Overall Objectives**: CDVI is an integrated, multi-purpose tool that can be used for a variety of purposes within the CCA project. However, it is unreasonable to attempt to address all of these possibilities in one CDVI session. CDVI should be used to satisfy key objectives within a community that are based on local needs. In other words, the specific objectives of any CDVI must be relevant to the community, clearly communicated, and continually referenced throughout the entire process. Once this process is complete, the model can be used again for additional purposes of CCA in the future.

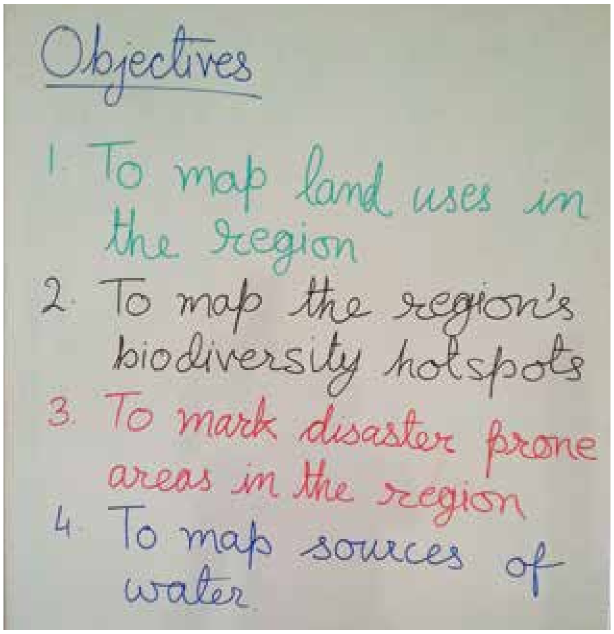


Illustration of possible objectives

2. **Size and Composition of the Participant Group**: The specific objectives for CDVI should be a driver for the participant group assembly. Facilitators must decide how many participants should be included in the process, and the specific community members that should be present. For example, if the specific purpose of CDVI is to gather indigenous knowledge on historic land use, then several key elders should be present in the participant group. If the purpose of CDVI is to provide educational outreach, then the participant group should represent the entire demography of the community, including both elders and young children, men and women. As a rule, a participant should be a strong representation of the greater village community.

3. **Location**: CDVI demands an open space where multiple groups of people can discuss and work together at once. The location should also be in a central location in the village to maximise transparency to those not directly involved in the process. Meeting Houses or temple courtyard works well work well for these purposes.

4. **Size of the Model**: Chosen objectives, number of participants, and location will influence the size of the model, and vice versa. A large model can accommodate more people, but will take more time and supplies will cost more. Facilitators must weigh these decisions in the planning process and commit before any other steps are taken in the CDVI process.

5. **Horizontal and Vertical Scale**: Scale and size are related, and also depend on the specific objectives. For example, if the purpose of CDVI is land use planning, smaller scales (1:10,000+) are useful because they cover

more area. However, if the purpose of CDVI is DRR, participants will need to identify individual structures, which will require a larger scale (1:5,000). For more on determining scales, see the Manual on Participatory 3D Modelling for Natural Resource Management.

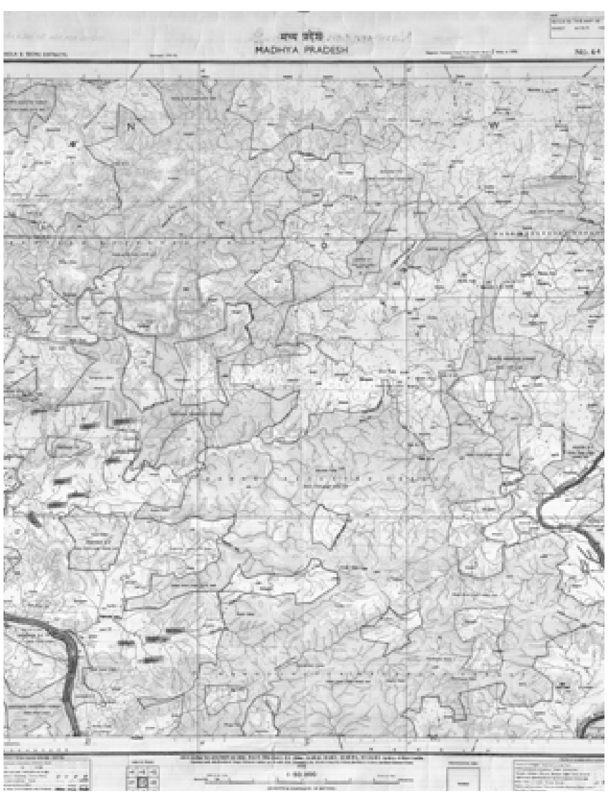
6. **Organizational Approach**: Facilitators must design the sessions to minimise confusion and maximise time use-efficiency amongst participants. The CDVI process lends itself to multiple ongoing tasks, such as cutting, tracing, and pasting contour layers, and so it helps to divide the participants into functional groups. The organisational approach to the CDVI process should be determined amongst facilitators, and this approach should be consistently followed to avoid confusion.

It is proposed that the layers are traced on the corrugated cardboard and cut prior to a CDVI workshop. The participants then paste the layers together in the proper order only. This approach cuts time from the workshop but also complicates transportation – large square cardboard pieces are easier and less delicate than the cut pieces. However, the facilitators may decide based on the overall objective, whether to trace and cut layers in the field with the participants, or prior to the event.

7. **Projected Budget and Estimated Timeline** for administrative purposes.

II. The Reference Map

The reference map will provide the topographical information necessary to construct the model. The size of the reference map will also determine the size of the 3D model. It is therefore a fundamental component of the CDVI and should be accurate. As Digital Elevation Models (DEMs) of the watershed are available, topographic contour layers may be extracted from these in 10 or 20 m intervals. 10 m intervals are ideal because they contain more detail. Other spatial data, such as hydrology, roads, settlements, or government boundaries can also be included on the reference map.



Reference maps should be prepared from the digital topographic data layers stored in ArcGIS and printed at the desired size and scale. If digital data is not available, one may use scanned topographic maps. In this case, the image is to be cropped to the desired area (as these maps tend to cover more area than desirable for a CDVI). Knowing the precise scale of the cropped image is impossible, which rules out transposing the resulting CDVI into GIS. Therefore, use digital data as much as possible so that the precise scale and size can be determined. It is advisable to print two or more copies of the reference map.

III. Supplies Procurement

Once the planning stage is complete, supply procurement can begin. CDVI supplies are readily available and can be found largely at art supply stores. These suppliers provide corrugated cardboard in varying thicknesses and will cut cardboard sheets to the needed size. Other supplies associated with the Base Model and the Demarcation processes can be purchased from any art supply store.

CDVI works best with corrugated cardboard – it is durable but also easily cut. It is also available in varying widths – 1 mm, 3 mm, 5 mm – and the width chosen for a CDVI model will depend on the chosen vertical scale, as each contour will have a corresponding height on the model. This is important not only for visual recognition, but also for spatial accuracy when a CDVI is transposed into a GIS. It is normally advised that the vertical scale should be the same as the horizontal scale, but depending on the local topography and the size of the model, it might be necessary to vertically exaggerate the model (i.e. make the vertical scale larger than the horizontal scale). Size, scale, as well as degree of vertical exaggeration of the model must be decided and calculated before purchasing the right type of corrugated cardboard.

A Supply List for Base Model Construction:

1. Corrugated cardboard: the exact size of the intended model; one sheet for each contour layer plus several extra sheets (for use in the case of mistakes).

2. Packaging tape: one standard-width roll and one wide-width roll.

3. Box cutters.

4. Ballpoint pens, pencils.

5. Permanent markers, for marking elevation and orientation on the corrugated cardboard layers as well as the base map.

6. Carbon paper, for tracing the contours from the reference map to corrugated cardboard layers.

7. Paste, for securing the superimposed corrugated cardboard layers.

1. Glue 2. White acrylic paint 3. Reference map
4. Thin paper sheet 5. Corrugated sheet 6. Carbon paper
7. Ruler

8. Newspaper-thin paper sheets (for covering/ priming model). Actual newspaper can be used.

9. White acrylic medium, for priming and sealing the base model (e.g. Camel brand).

10. Reference map, at least two copies.

A Supply List for Model Demarcation:

Note: The colours chosen for the model should be very distinct to one another to ensure clear boundaries between two features. In other words, light yellow and yellow should not be used together on the same CDVI, although dark green and light green may be possible. It is sometimes advisable to use colours that visually resemble natural landscape features, such as blue for water and dark green for forest. However, this is not always necessary, nor possible. As long as a legend is created and well established, any bright colours are good options for CDVI features. Colours should be chosen before going out to get supplies. All pins, yarn, and paints should be gathered in the chosen colours.

Facilitators may choose to use a reference grid on the model and the reference map for ensuring the spatial accuracy of certain features. In this case, additional supplies are needed.

1. Pencils for marking landscape features prior to permanent marking.

2. String or twine for creating a reference grid on the model (optional).

3. Ruler or tape measure for drawing corresponding reference grid on the reference map (optional).

4. Pins with coloured heads for mapping point features (e.g. wells, homes).

5. Yarn for marking line features (e.g. roads, forest boundaries, territorial boundaries, streams).

6. Acrylic paint for painting features of large areal extent (e.g. lakes/reservoirs, cultivated land, protected forest). Commonly-used colours – green, yellow, brown, hot pink/ magenta, purple, red, orange, black.

7. A large poster board for posting the final legend. This should be large and posted in a place for all participants to use and reference.

8. Permanent markers for writing the legend.

9. Paint brushes of varying widths.

10. Plastic cups for cleaning paint brushes.

11. Scissors.

1. Acrylic Paint 2. Yarn 3. Scissor, Ruler, Cutter, Colour Pins, 4. Paint brushes

Other Supplies for Facilitators

1. Digital camera, to document progress for future reference.

2. Digital voice recorder, for recording indigenous voices, important knowledge, stories, etc.

3. Whiteboard and dry-erase markers, to help in facilitator explanations, or general knowledge-sharing.

4. GPS, for verifying the locations of some features (optional – but necessary for digitisation).

All supplies and plans should be organised and prepared for transport to the construction location, where the CDVI workshop will begin.

1. Voice Recorder 2. Camera 3. GPS

III. Orienting and Preparing Participants (Day 1)

To initiate the CDVI workshop, facilitators should communicate the intentions of the workshop, the basic concept of CDVI, the objectives of the model (i.e., exactly what the model will be used for, whether or not it is digitised).

Facilitators should make a point to establish relationships of trust amongst participants and between participants and facilitators, as these relationships facilitate the emergence of necessary indigenous knowledge to the CDVI. Facilitators should clearly understand their roles as well as the roles of the participants. It should be stressed by facilitators that the CDVI workshop is meant to provide a collective space of knowledge-sharing that will prepare the community to address concerns and needs related to the CCA project. It is suggested that the objectives are written on a large paper or poster board and posted for everyone to see throughout the process.

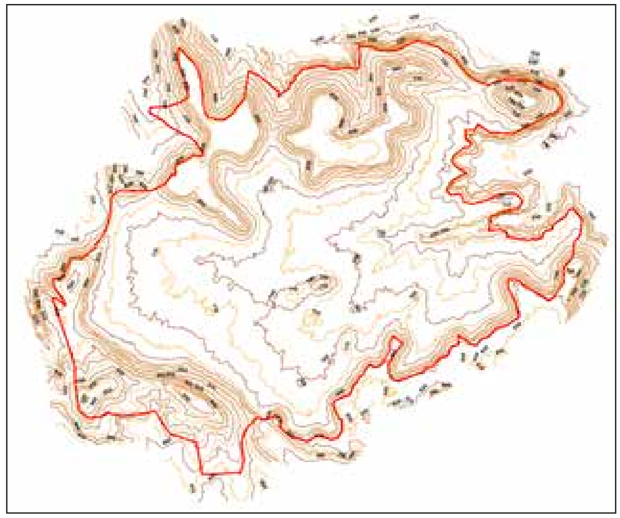
Also in this stage, facilitators will divide participants into functional groups with assigned tasks for the construction process. If facilitators decide that this would not cause confusion, functional groups should rotate tasks so that everyone has a chance to participate in all elements of the CDVI.

IV. Base Model Construction (Days 1-3)

The following is a basic step-by-step process for constructing the CDVI model. It is suggested that facilitators have familiarized themselves with this process so that they are ready to confidently lead participants.

Tracing Elevation Contours from the Reference Map

1. Ensure that the contours on the enlarged topographic map are clearly labeled with the correct elevation. This is necessary to avoid mistakes in the tracing process. Mark which direction is north, as this will continually be an orientation reference throughout model construction.
2. Tape carbon paper sheets to the bottom of the enlarged topographic map so that the bottom of the map is completely covered. The side of the carbon paper that marks should be facing outwards (marked side facing map, plain side facing out). There should be no white space showing. Carbon paper sheets may need to be trimmed so that they fit the map correctly.



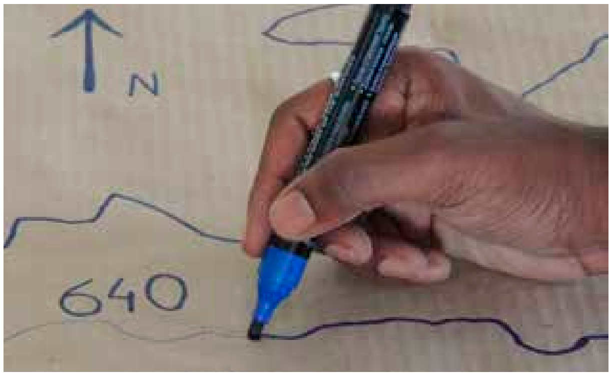
3. Overlay the reference map/carbon paper over a sheet of corrugated cardboard, so that the topographic map is facing upwards. The map should be EXACTLY the same size as the cardboard layer.
4. Secure the map on the cardboard layer with pins so that it does not move while tracing.

DO NOT USE TAPE or the map will rip. Keep in mind that the map/carbon paper must remain well intact. Secure all subsequent cardboard layers to the map using the same pinholes.

5. You are ready to begin tracing a single contour. It helps to begin with the lowest elevation and work towards higher elevations. Using a sharp pencil or ballpoint pen, trace along a single contour line (e.g. 720 m). Make sure that all contour lines of the same elevation are traced. Don't forget about isolated mountain peaks (this will become more important with increasing elevation). While tracing, be sure to stay as close to the appropriate contour interval as possible to maintain the spatial integrity of the resulting model. This is important especially with small-scale maps (1:10,000+).

6. Lift the paper slightly to ensure that the carbon paper has properly transferred your tracing to the cardboard layer. If so, remove the bottom cardboard layer and replace it with another.

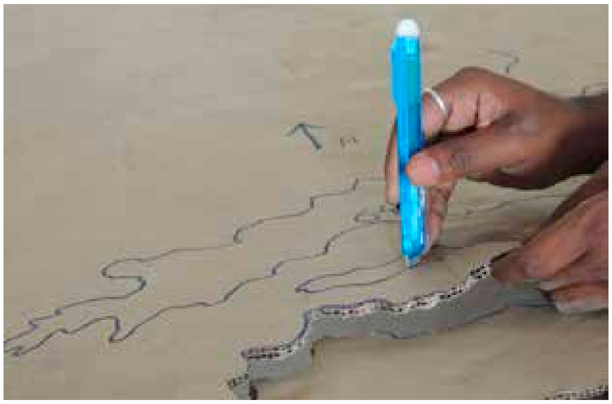
7. Using a permanent ink pen, clearly mark the cardboard layer with the contour elevation and a north-pointing arrow. Make sure that disconnected contour intervals (such as those on mountain peaks) are labeled and oriented also, as they will be cut and possibly separated from others.



8. Repeat steps 4–7 until all elevation contours have been traced, each on a single cardboard Layer.

The Contour Layers

9. Now it is time to cut out and trim the cardboard contour layers. If you are working in multiple task groups, this step can begin as soon as the first contour is traced, and can be happening simultaneously with tracing, which is a more efficient use of time.



10. Keep traced and cut layers organised as they accumulate to avoid losing small pieces.

11. Once all layers are traced and cut, the model can then be assembled.

Assembling the Base Model

12. The CDVI should be assembled on a single layer of corrugated cardboard (same size as the model, uncut). This represents the lowest elevation in the covered area.

13. Apply a layer of paste to the top of the lowest layer, and then overlay the next higher elevation layer.

14. Repeat step 13 for each additional elevation contour layer (e.g. 720 m, followed by 730 m, 740 m, 750m, etc). Ensure that the layers are superimposed in the correct order and orientation, and are placed in precisely the same corresponding locations where they were traced on the reference map.

15. It may be necessary to place paint bottles, stones, or other heavy objects on the model while it is drying to ensure the layers do not slip out of place.

16. Allow the model to dry completely.

Priming the Base Model

17. Cut or tear sheets of newspaper-thin paper into strips or small squares. This can be assigned to a single task group.

18. Using paint brushes, paint a very thin layer of white acrylic primer on a small area of the model.

19. Press the paper onto the area, so that the paper is flush to the surface but minimises the appearance of the contour layers.

Stick paper on the model

20. Paint another thin layer on top of the thin paper.

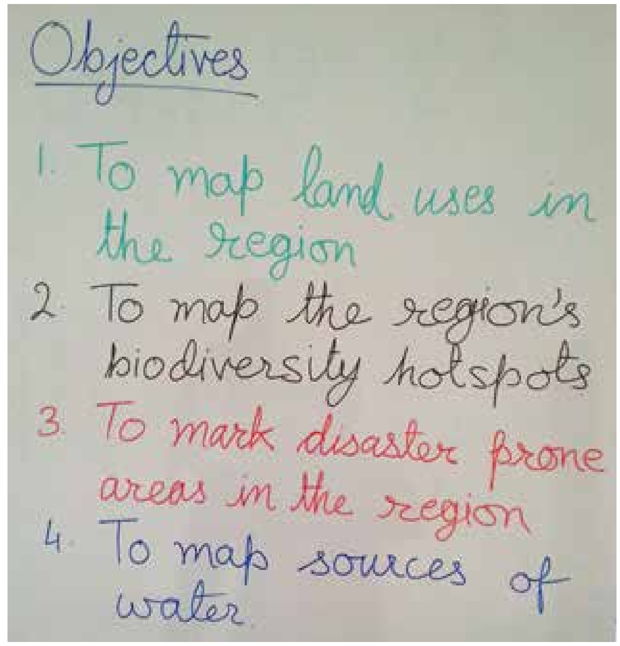
21. Continue steps 17-20 until the model is completely covered in a single layer of paper/primer.

22. Let the model dry completely.

V. Preparation for Model Demarcation (Day 4)

The blank model is complete, and now facilitators must begin a process by which the participants will use their instinctive and inherent knowledge of and relationship with the landscape to demarcate the model. However, before any mark on the model is made, the following tasks must be executed by the facilitators.

1. Revisit the Objectives: This is a good time to revisit the original objectives of



CDVI. Facilitators should engage with the participants to remind them why the blank model was built in the first place. This discussion helps to bring everyone back to the original purpose of the workshop after all of the technical construction activities.

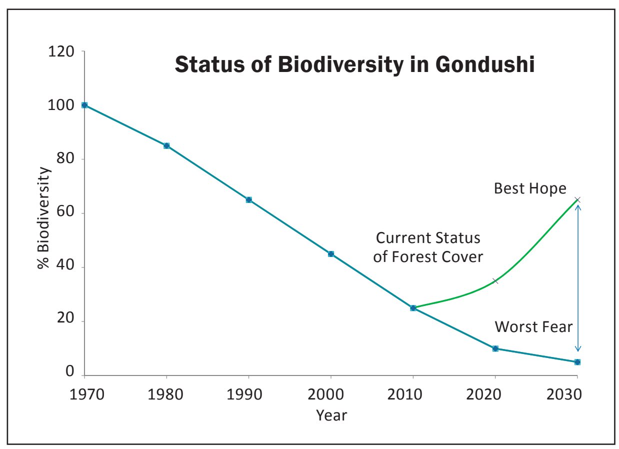
2. Introduce the Demarcation Process (explained below): Facilitators should present the necessary process for demarcating the model to accomplish these objectives. A step-by-step process should be explained to the participants, and it is compulsory that the process is universally understood before beginning demarcation.

3. Encourage Precursory Discussion amongst Participants: Facilitators must ask participants what features should be placed on the model, based on the overall CDVI objectives. In these discussions, facilitators should gauge participant reactions, observations, and motivation levels to ensure that everyone is on a positive track with the intentions of the model and the process involved.

4. Create the Map Legend: The most important part of this preparatory stage is the creation of the legend. The legend is the reference code for all features placed on the model by participants. It is therefore essential that the participants have complete control over the creation and establishment of the legend, with technical assistance from facilitators. The legend should include all basic familiar landmarks and landscape features, such as bridges, important hilltops, settlements, temples, streams, rivers, and reservoirs. In addition, the participants will identify features relevant to the CDVI objective at hand. For example, if this model is being used for biodiversity initiatives within CCA, then the legend should also include a symbol (or colour, rather) for biodiversity hotspots. It is compulsory that the model legend is completed, posted, universally understood, and followed consistently amongst both facilitators and participants throughout the demarcation process.

VI. Demarcating the Model (Days 4–6)

Now begins the most important process of CDVI, by which the blank model is demarcated by the participants. This is a very delicate space, as community knowledge is shared among men and women and across generations. Facilitators should intervene only when necessary, allowing stories, conflicts, and collaboration to occur on its own. Facilitators may feel the need to ask guiding questions throughout this process that may stimulate discussion, such as “How has the landscape changed in your lifetime?”, or “How do you define the boundaries of your domain?”. Guiding questions should of course be relevant to the overall objectives. Regardless, it is important to remember that this collaborative space should be nurtured and reinforced by facilitators, and not dictated.

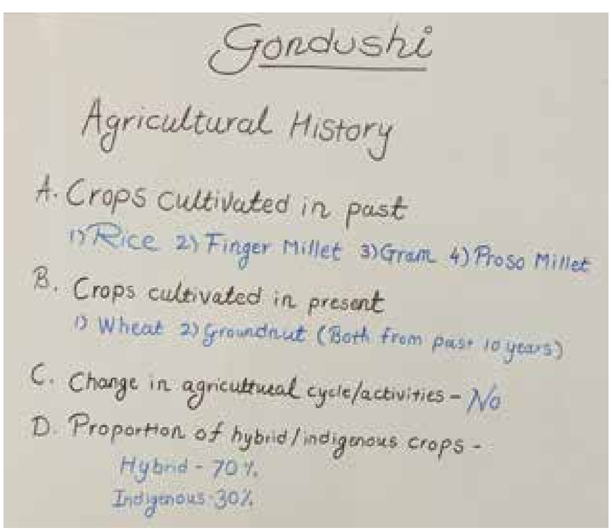


The demarcation process may take anywhere between 1–3 days, depending on the size of the model, the social dynamics of the participant group and the objectives of the workshop. The following is a step-by-step summary of the demarcation process.

1. Gather the participants around the model. Provide pencils for initial demarcation. Facilitators should encourage the

conversations to remain open to the entire group. Allow participants to discuss and sketch, referring to the legend and the reference maps, until they feel that the model is ready to be permanently demarcated. Depending on the objectives and the size of the map and the attention levels of the group, this process may take an entire day at most. Facilitators are discouraged from rushing the process.

2. Facilitators should heavily document conversations and interactions for future reference in further CCA initiatives, as often key social conflicts or financial/ environmental concerns from the community are revealed through this process.



3. Once the features have been pencilled in, the model will be ready for permanent demarcation using pins, yarn, and paint. Again, pins are used for point features, such as wells or temples. Line features are used for roads, bridges, rivers, etc., and paint will be used to show features of areal extent, such as conserved forest area or farmland. This protocol should be consistently followed throughout the demarcation process, especially if the model is to be transposed into GIS, to avoid confusion and error. It is also ESSENTIAL that the participants adhere to the legend they created in preparation.

4. Facilitators are also responsible for making sure the supplies are available and in order: paints, brushes, cups of water for washing brushes, scissors, yarn, and pins throughout the process.

VII. Formally Concluding the Process (Day 7)

When the demarcation process is complete, the model should be formally handed over to the participant group and introduced to the community as a whole. Facilitators should revisit the original objectives with the participants, discuss any changes or adjustments, and take note of observations and feedback from

participants. There should be discussion about the impact of the model and the various possible objectives that the model could accomplish in the future. The model now officially belongs to the community as a part of CCA, and facilitators should ensure that the model will be displayed in a public place and cared for in their absence. A concluding ceremony isn't always necessary, but it helps to ensure all participants have a sense of closure with CDVI and that the model has been made available for the entire community. At this point, CDVI is complete.

While CDVI without digitisation is highly valuable, digitisation maximises its benefits in terms of wider communication to research institutions and policymakers. The next step is to develop a digitisation protocol that can supplement this handbook, to complete CDVI as an official tool for CCA.

8. Conclusion

The CoDriVE-Visual Integrator possesses substantial enhancement potential for increasing stakeholder participation in a development project and more so for Climate Change Adaptation. As a comprehensive technical and educational tool for environmental decision-making at the grassroots level, CDVI is unique in that it provides local communities a 'hands-on' experience on a tangible model which can be used in many ways. In addition, as it is derived from digitized maps digitised maps representing indigenous spatial knowledge, it can be used at organisational, governmental, or academic levels as well. CDVI has the potential to be an important channel of communication between government and village communities that have historically been blocked by institutional hierarchies and sociopolitical inequities. It brings the village voices to the policy-making table. Perhaps more importantly, village communities feel more connected to development interventions with the creation of a CDVI as the process is conducive to increased community cohesion and confidence by way of indigenous knowledge exchange.

CDVI can be used as a supplement to the various CCA initiatives, applied independently or collectively, the constraints being lack of significant human resources and time commitments required by the system. Any

CDVI initiative should be allowed ample time in all stages as time constrains severely limit the flexibility of the model's use and the information that can be drawn from participants. If an institute can devise means to overcome these time- and human-resource constraints, CDVI can greatly enhance a CCA project, or for that matter, any rural development project in almost every respect.

This document is meant to serve potential CDVI practitioners within the CCA sphere, as well as those looking to further develop the tool in innovative ways in any development context. Practitioners (current and potential) are encouraged to further develop CDVI and to continue to supplement and ratify the information outlined here. Enjoy the discovery as you go along!

In Partala, Madhya Pradesh

1. Participants assembling corrugated cardboard layers for the first time.
2. Referring to the reference map.
3. Priming the model.

4. Completed blank base model.
5. Beginning demarcation with pins and yarn.
6. Painting final features.
7. The final model.

CoDriVE
VISUAL
INTEGRATOR

Glimpse of process in practice

At Gondushi Village, Maharashtra

The following report describes the process of developing a Community Driven Vulnerability Evaluation – Visual Integrator (CDVI) in villages. In village Gondushi in the Akole block, Ahmednagar district, a two-day workshop was organized. It was the first time the village had participated in such an activity. The process of this two-day event is described here.

DAY 1: 17 February, 2013

The workshop was planned and conducted in the village temple as it has sufficient space and is strategically location i.e., in the middle of Gondushi village. Approximately 60 village residents, mostly men, gathered. Due to unavoidable circumstances, many women of the village were unable to attend on day 1.

Introduction of the Purpose and Setting the Objectives
The team leader introduced the team to the participants and the reason for this workshop.

The objectives were: To develop a 3D model of the village together with the participants

To identify and locate the hotspots for biodiversity, changes in the agriculture and the disaster prone areas in the village.

The concept of a 3D model was illustrated by placing three objects on the ground, which the participants were asked to draw from different angles, always retaining the height. This activity helped the villagers to understand the concept of 'aerial view' perspectives.


Village participants assembling the model


Camera mounted on top of the model

Facilitator explaining the layout of the model

Constructing the 3D model of the village: The participants were given the task of constructing a 3D map of the village and its surroundings. They were provided with a contour map that was fixed to the wall, and a number of unsorted corrugated cardboard sheets that were pre-cut according to the contours of the village landscape. These were placed in an open space to facilitate further work. The participants took an hour to construct the model, with some tips and hints along the way. They soon realised that each sheet was numbered and marked. Once the model was completed, it was brought back inside for the next stage.

Meanwhile, the facilitating team had set up an overhead camera between the rafters that would provide a vertical (aerial) view of the model.

Building the model

Guided by the facilitating team, the participants constructed the model and were instructed to glue each sheet in place. At this stage, the model resembled a 3D representation of the contour map fixed to the wall.

Day 2: 18 February, 2013

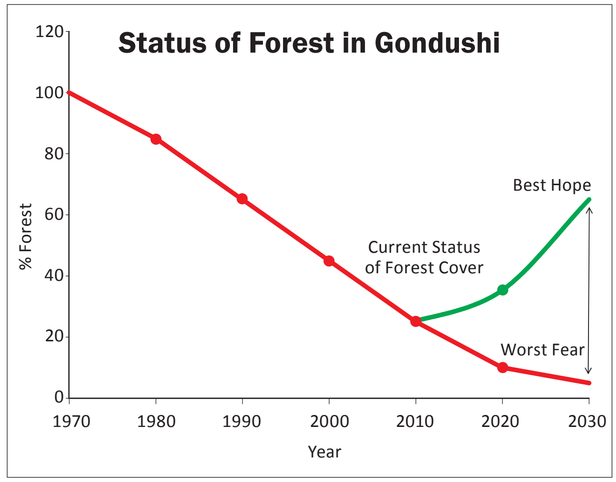
Team Building Exercise

A group activity was conducted to highlight the message that while doing any task/work in the village, coordination and unity of purpose is essential. 'Lifting the Paper Roll' is one such activity. Participants keen in being involved were asked to support a roll of paper roll on their fingers tips and together lower the tube without losing contact. This exercise was found challenging and evoked laughter. However, the relevance of working in coordination towards a common end with one another was learnt.

On day 2 women joined in the workshop. Their contribution was of immense help in increasing the accuracy of the CDVI. Their knowledge

Participants involved in team building exercise

Elderly women showing showing landslide prone area in the village.



Graphical representation of the village's history

of wells, springs, and forest was much more precise, as it was they who collected water and wood from the most convenient sources.

Discussion about the history of village

Obtaining the history of the village is important. This began with finding out about the origin of the village name. No one present had any idea of its roots, which was probably due to the absence of any elders in the workshop.

Points emerged from discussion

1. On discussing about crop history, it was learnt that traditionally people grew paddy (various indigenous varieties), gram, nachni (Finger millet), warai (Proso millet), and a few pulses. During the last 10 years, wheat and groundnut had been introduced. The local community prefers local varieties over hybrid varieties.

2. Land use: According to the women, 75 percent of the village land was earlier covered by forest, with hardly any human settlements. These were gradually encroached upon for agricultural use, resulting in proliferation of hamlets. Most of the forest being privately owned, there was no protection from encroachment. The women believe that only about 25 percent of the forest remains today.

3. Disaster hot spots: Villagers discussed about various land based disasters that occurred in the village and potential sites. These hotspots identified are: landslide prone areas, open wells without a rim (at ground level), dilapidated houses and structures and sites of possible electrocution hazard. After seeing it on the model, the people realized the need to have these urgently addressed.

Graphical presentation

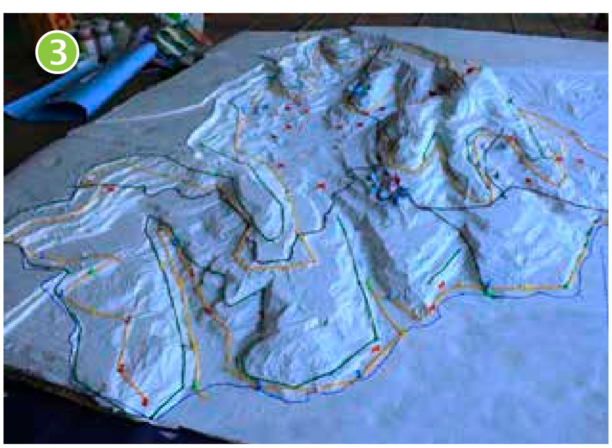
Based on the information provided by the villagers, a graphic representation of the rate of depletion of the forest cover over the last 30 years was plotted. Participants did not have any idea of the rate of forest depletion so it was assumed that it happened gradually at a constant rate. After agreeing on the present condition of forest cover, the participants were asked if they could forecast what would happen to the forest cover in the next twenty years, if the current trend continued. In response, the participants traced a graph where all the forest cover would disappear in 20 years. The participants were then asked to visualize what they would prefer to see happening over that same period. To this they responded that they would like to see its restoration to its previous state. The graph helped them understand the gap between the likely scenario of total forest depletion and their dream for its restoration. Rather than providing solutions, the exercise left them with this question: "What can be done to reduce the gap?"

Next Steps: Having this 3D model of their village, all participants, young and the elderly, women and men eagerly shared about the various important spots of the village. They then decided that in another village level meeting the participants and other villagers would work on the hazard and disaster prone hotspots of the village. They felt confident that with the help of this tool they would be able to communicate effectively to government officials and outsiders about their village and plans.

The following is a brief guide to the steps required to construct the CDVI:

Selecting, placing and pasting of contour (cardboard) boundaries, one above the other

Pasting of white paper on to the glued cardboard sheets creating a more realistic facsimile of the sloping terrain.



Completed model with roads and field boundaries added by using coloured yarn and pins.

Model marked with village boundary, roads, wells, springs, temples, human settlements, agricultural area, irrigated areas, forest area, waste land, and drainage.

Final model complete with legend

Glossary

Adaptation
Adjustment(s) in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.

Aquifer
A stratum of permeable rock that bears water. An unconfined aquifer is recharged directly by local rainfall, rivers and lakes, and the rate of recharge will be influenced by the permeability of the overlying rocks and soil. A confined aquifer is characterised by an overlying bed that is impermeable and the local rainfall does not influence the aquifer.

Biodiversity
Biodiversity is a variety of all forms of life. It is the variability among living organisms and their habitats, including the diversity within species, between species and within ecosystems.

Biodiversity hotspot
A biodiversity hotspot in the context of a village is an area which holds significant diversity of flora, fauna, and microbes.

A biodiversity hotspot in the global context is a biogeographic region with a significant reservoir of biodiversity that is under threat from humans.

Capacity building
An ongoing process through which individuals, groups, organisations, and societies enhance their ability to identify and meet development challenges.

Cartography
Cartography is the study and practice of making maps.

Critical Habitat
Critical habitat is an area essential to the conservation of globally threatened and ecologically important species.

Climate
Climate is the pattern of variation in temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric particle count, and other meteorological variables in a given region over long periods. Climate can be contrasted to weather, which is the present condition of these variables over shorter periods.

Climate change
Climate change is a significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years. It may be a change in average weather conditions, or in the distribution of weather around the average conditions (i.e., more or fewer extreme weather events).

Community Based Disaster Risk Reduction (CBDM)
It is the process in which community at risk are actively engaged in the identification, analysis, treatment, monitoring, and evaluation of disaster risks in order to reduce vulnerabilities and enhance their capacities. Community Based Disaster Management is a community driven, bottom-up approach.

Digital Elevation Model
A digital elevation model is a digital model or 3D representation of a terrain's surface. In most cases the term represents the earth's surface and includes all objects on it.

Ecosystem
An ecosystem is a community of living organisms (plants, animals, and microbes) in conjunction with the non-living components of their environment (things like air, water and mineral soil), interacting as a system.

Ecosystem services
Ecosystem services provide us resources for living and livelihoods as well as clean up and detoxify the waste that we generate and convert them afresh into usable resources. Human beings benefit from a multitude of resources and processes that are supplied by natural ecosystems. Together, these benefits are known as ecosystem services and include products like clean drinking water and processes such as the decomposition of wastes.

Hazard Hotspot
An area with the potential occurrence of a natural or human-induced physical event that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources.

Land use
The management and modification of natural environment or wilderness into built environment such as fields, pastures, and settlements.

Livelihood(s)
Livelihood is defined as a set of activities, involving securing water, food, fodder, medicine, shelter, and clothing, and the capacity to acquire above necessities, working either individually or as a group by using endowments (both human and material) for meeting the requirements of the self and his/her household on a sustainable basis with dignity.

Population Hotspot
High density of humans at a particular place (highly dense population) which is prone to disaster.

People's Biodiversity Register (PBR)
Register prepared by people for their own village, creating a snapshot of local biodiversity, cultural practices and various aspects of people's life at the same time providing a sensing of change over time.

Resilience
The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change.

Resources
A resource is a source or supply from which benefit is produced. Typically resources are materials, money, services, staff, or other assets that are transformed to produce benefit and in the process may be consumed or made unavailable. Benefits of resource utilisation may include increased wealth, meeting needs or wants, proper functioning of a system, or enhanced well-being.

Sustainable Agriculture
Sustainable agriculture is the act of farming using principles of ecology, the study of relationships between organisms and their environment.

Sustainable Development
Sustainable development refers to a mode of human development in which resource use aims to meet human needs while ensuring the sustainability of natural systems and the environment, so that these needs can be met not only in the present, but also for generations to come.

Self Help Group
SHG is a group of about 10 to 20 people, usually women or men from a similar class and region, who come together to form savings, and credit organisation. They pool financial resources to give small interest bearing loans to their members.

Vulnerability
The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard. This definition identifies vulnerability as a characteristic of the element of interest (community, system or asset) which is independent of its exposure. However, in common use the word is often used more broadly to include the element's exposure.

Wasundhara Sevaks
A cadre of trained village youth to mobilise awareness among the communities and implement various aspects of a Climate Change Adaptation project, like biodiversity conservation, disaster risk reduction, weather data collection, water budgeting, the watershed and soil & water conservation treatments, and others as needed.

About WOTR

Aware of the fragility of ecosystems and our symbiotic link with it, WOTR has since 1993 applied a systems-based approach to watershed development, focusing on people-centric participatory interventions. With more-than-normal weather variations now being experienced, WOTR has moved into an Ecosystem-Based Adaptation (EBA) approach that helps vulnerable communities build resilience of their degraded ecosystems and livelihoods threatened by climate change impacts. This approach generates significant benefits, social, economic, and cultural.

WOTR is now oriented and equipped to specifically address the challenges (and opportunities) posed by climate change to vulnerable communities. In the process, WOTR has introduced a bottom-up, holistic and integrated approach towards Adaptation and Resilience Building.

Constantly learning from experience, WOTR has been revisiting conventional development. **Systems Thinking and Complexity Analysis** have been incorporated in programme design leading to formulation of new tools and frameworks while adapting the existing ones. This helps us shift to a Framework-Based Management, in contrast to activity focussed projects.

At WOTR, Applied Research is a constant companion. Our team, guided by experts, help local communities become researchers – observing, measuring, and assessing for themselves problems as also improvements that a project brings about. Having tested methodologies, WOTR disseminates the learning through Capacity Building Events to implementers and donors, far and wide, so as to benefit rural communities across India and to countries in the South.

WOTR has carried out developmental work in over 2,500 villages in six states. Its programme on Climate Change Adaptation project is currently being implemented in over 70 villages in Maharashtra, Madhya Pradesh, and Andhra Pradesh.

For more information visit us at **www.wotr.org**

This tool, CoDriVE Visual Integrator (CDVI) is the outcome of an effort that began in 2011 to enhance stakeholder involvement. It identifies key hotspots and coldspots in their local geographies tracking negative and positive developments and the impacts of a changing climate.

CDVI is a simple to apply tool. It gathers spatial information held within the indigenous knowledge of project villages regarding natural resources, cultural values, environmental or social vulnerabilities and landscape information. The result is a three-dimensional, scaled relief model that presents the prevailing biophysical and anthroprogenic scenario to village community members, local administration and project designers. It thus facilitates dialogues for effective project planning.

Future opportunities for the tool, such as model digitization, will further increase project robustness. The purpose of this manual is to the guide the CDVI implementation process by bringing all relevant stakeholders onto one platform to be able to take appropriate decisions.