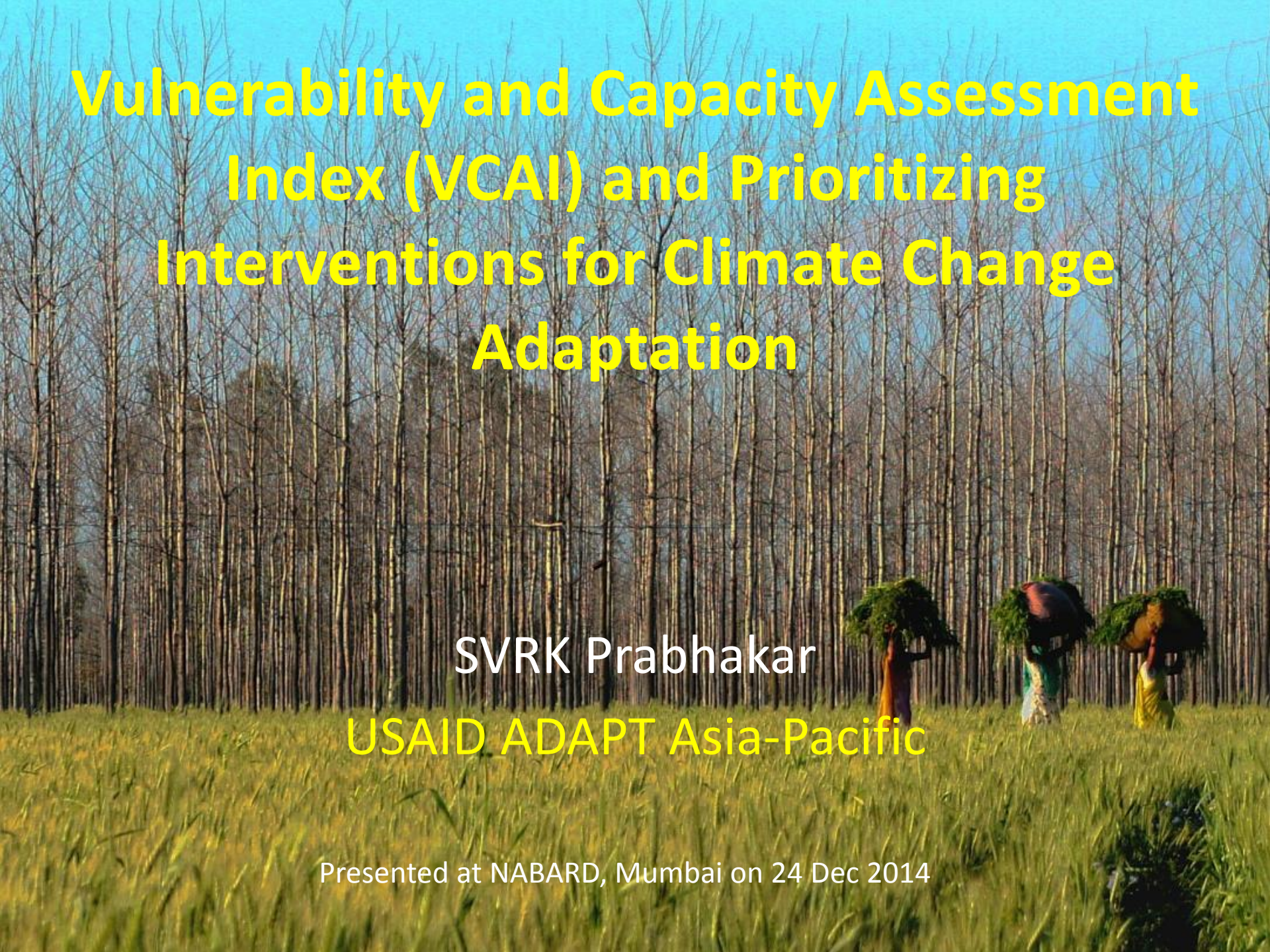
Vulnerability and Capacity Assessment Index (VCAI) and Prioritizing Interventions for Climate Change Adaptation



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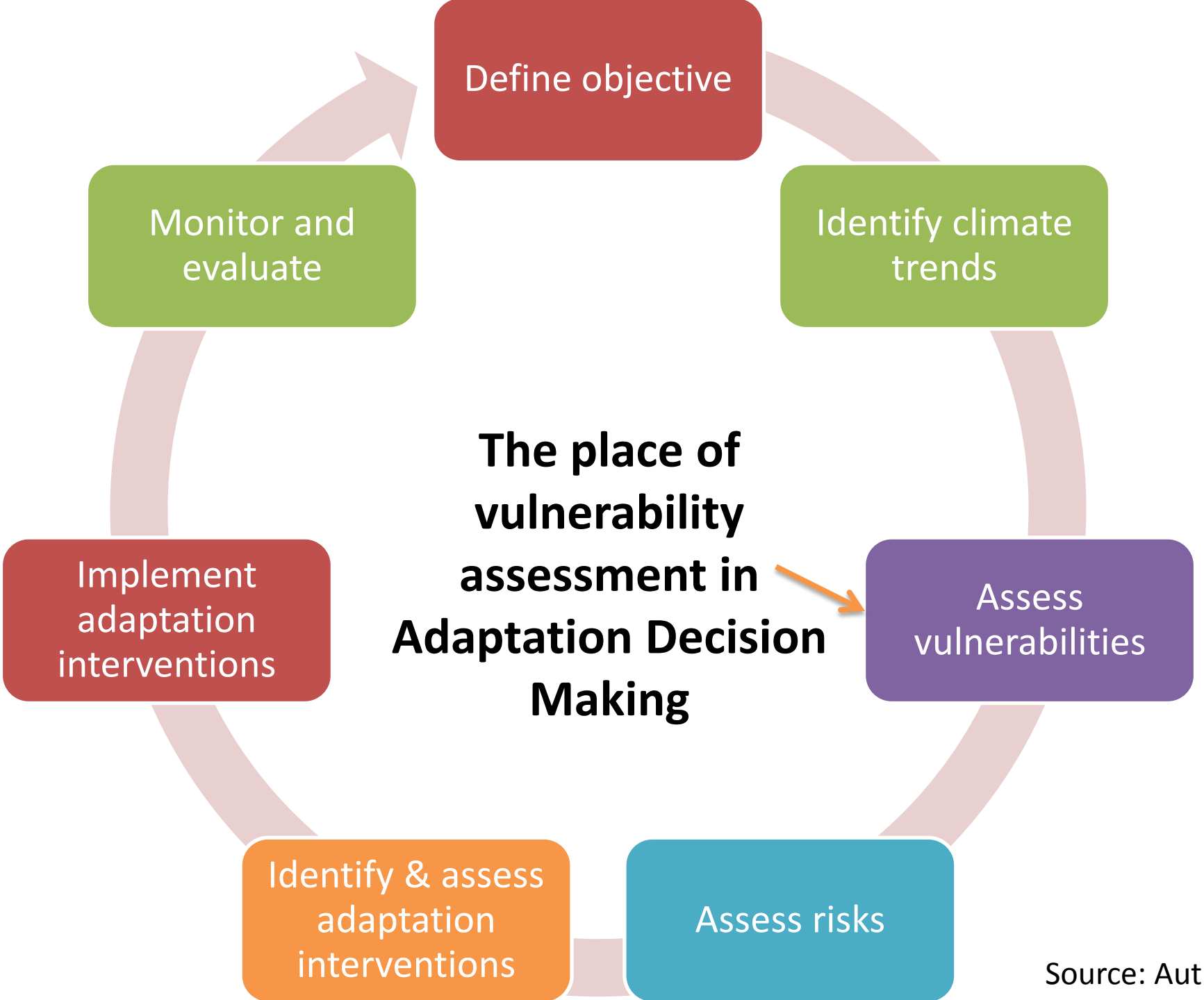
Presented at NABARD, Mumbai on 24 Dec 2014

Contents

- Work plan for this visit
- Vulnerability assessment methodology
  - Introducing VCAI excel tool
- Introduction to multi-criteria decision making
- Future steps

Expectations From this Mission

- Present the draft methodology to NABARD staff and obtain feedback
- Discuss the ways to obtain additional feedback on weights and thresholds for indicators and sectors
- Discussion on multi-criteria methodologies for prioritization of adaptation practices and capacity building of NABARD staff on vulnerability assessment and adaptation prioritization



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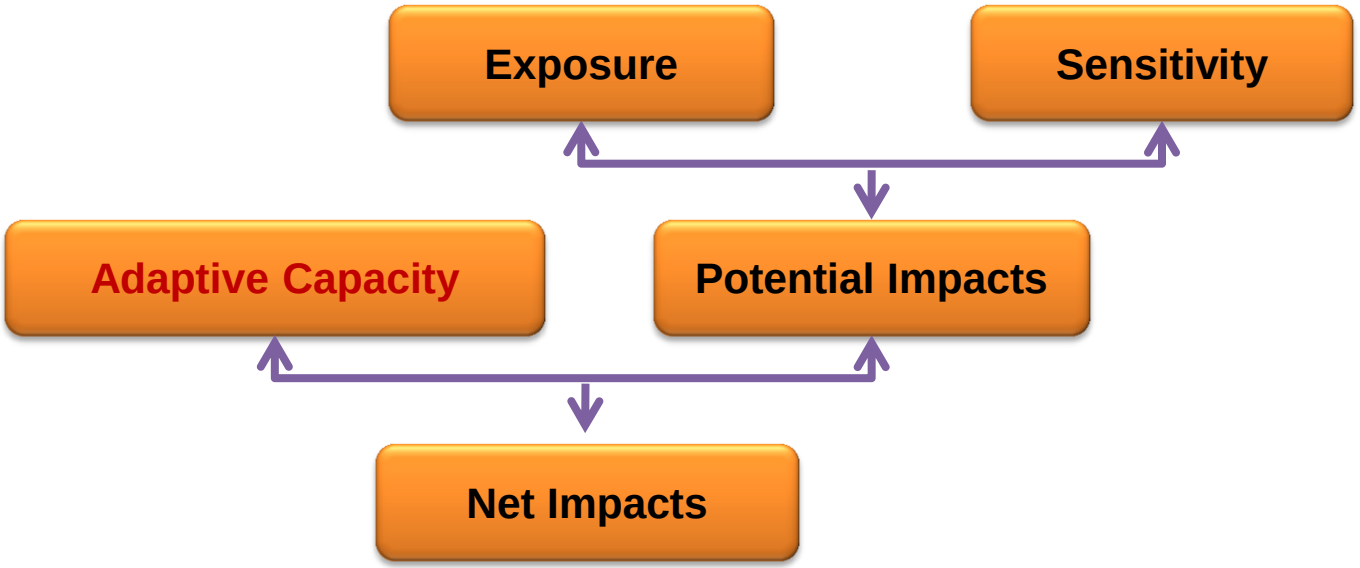
Vulnerability & Adaptive Capacity



Source: Author

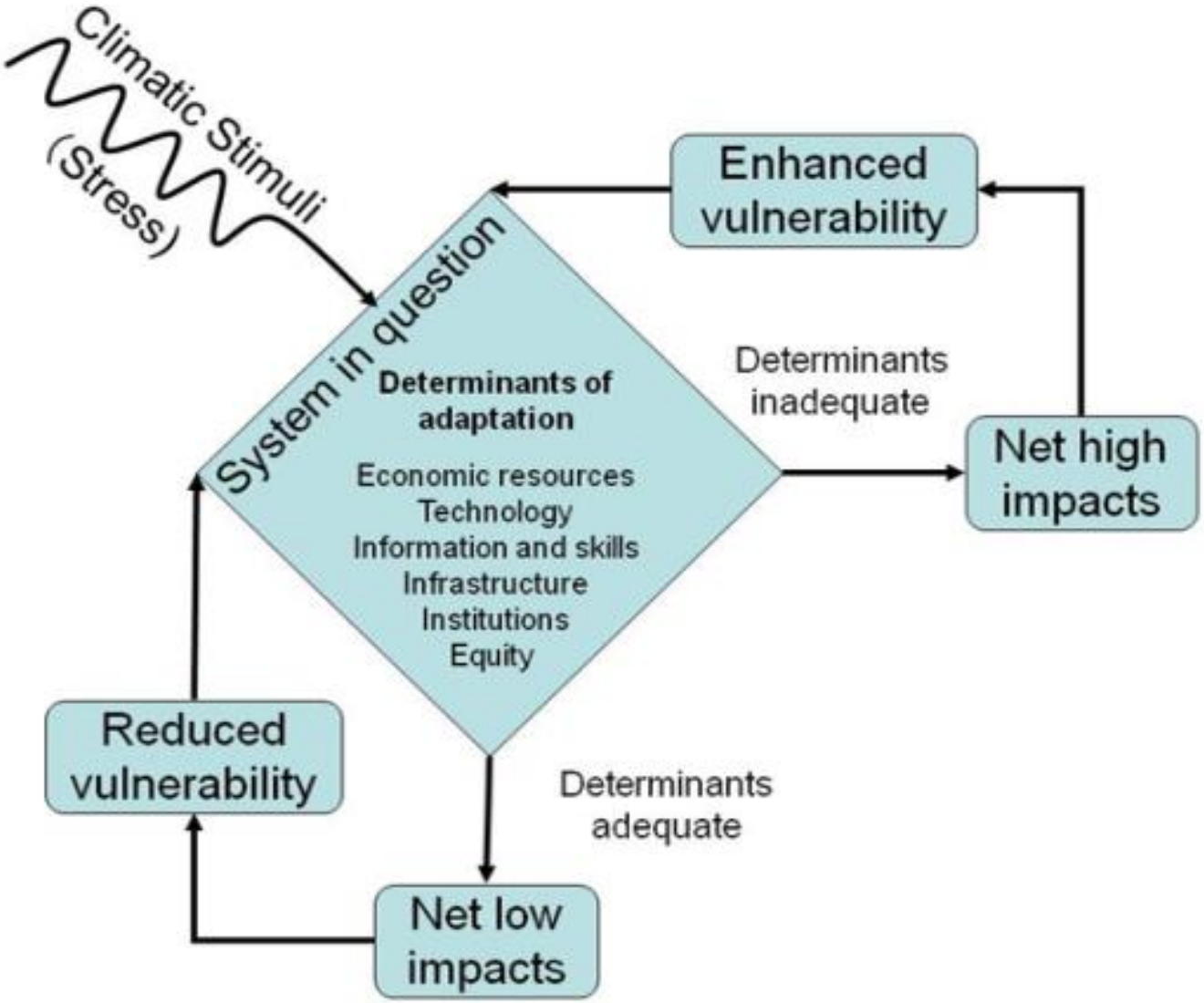
Exposure: Related to external pressures i.e. hazards
Sensitivity: Related to that of the social and ecological system, obtained through observations by the
Potential impacts: Field surveys and group discussions
Net impacts: Qualitative assessments

Framework for defining Vulnerability

$$\mathbf{V} = \mathbf{f}(\mathbf{E}_{xt}, S_{xt}, A_{xt})$$ (Smit and Pilifosova, 2003)

- V= current vulnerability (damage a system will incur if it experiences climatic hazard in its present state)
- E= Exposure of system x at time t
- A = Adaptive capacity of system x at time t

Critical Thresholds



Source: Prabhakar and Srinivasan, 2010

Conceptual Frameworks for Assessing Vulnerability and Adaptive Capacity

- **ACCRA Framework**: More Conceptual
- **Nick Brooks et. al. (2005)** : Semi quantitative, heavily relies on weighing factors and proxy indicators, mostly useful at broader scales such as national and regional
- **CSIRO Framework**: Conceptual (and qualitative)
- **Adger et al. (2007)**: Conceptual, qualitative
- **Yohe and Tol (2002):** Quantitative, broad scales
- **Swanson et. al. (IISD, 2010):** Based on the conceptual model of Smit and Pilifosova (2003): Comprehensive and quantitative. Employs determinants approach (Economic, technology, information, infrastructure, institutions, & Equity).

VCA Methodologies: Tools

Frameworks and Tools	Vulnerability	Exposure				Sensitivity				Capacity			
	Vulnerability as function of S, E, & C	Current climate trends	Climate-induced events	Climate projections	Community based and scientific data	Current hazard trends	Biophysical impacts	Livelihood impacts	Hazard prioritization	Coping strategies	Livelihood assets	Awareness/knowledge	Capacity to plan and effect change
A framework for social adaptation to climate change, IUCN	✓	✓	0	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Climate vulnerability and capacity analysis, Care	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	0	✓
CVAAA, SPREP & CIDA	✓	✓	✓	✓	✓	✓						✓	
Vulnerability to resilience, Practical Action	✓	✓	✓	✓	0	✓	✓	✓	✓	✓	✓	✓	0
Participatory tools for assessing climate change impacts and exploring adaptation options, LFP & UKAID	Not clear	0	✓	0	✓	✓	✓	✓	✓	✓	✓	0	0
Adaptation toolkit, Christian Aid	Not clear	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	0	✓
CRiSTAL, IISD			✓			✓		✓		✓	✓		
CEDRA, Tearfund		✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
CBA, IIED	Broad	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

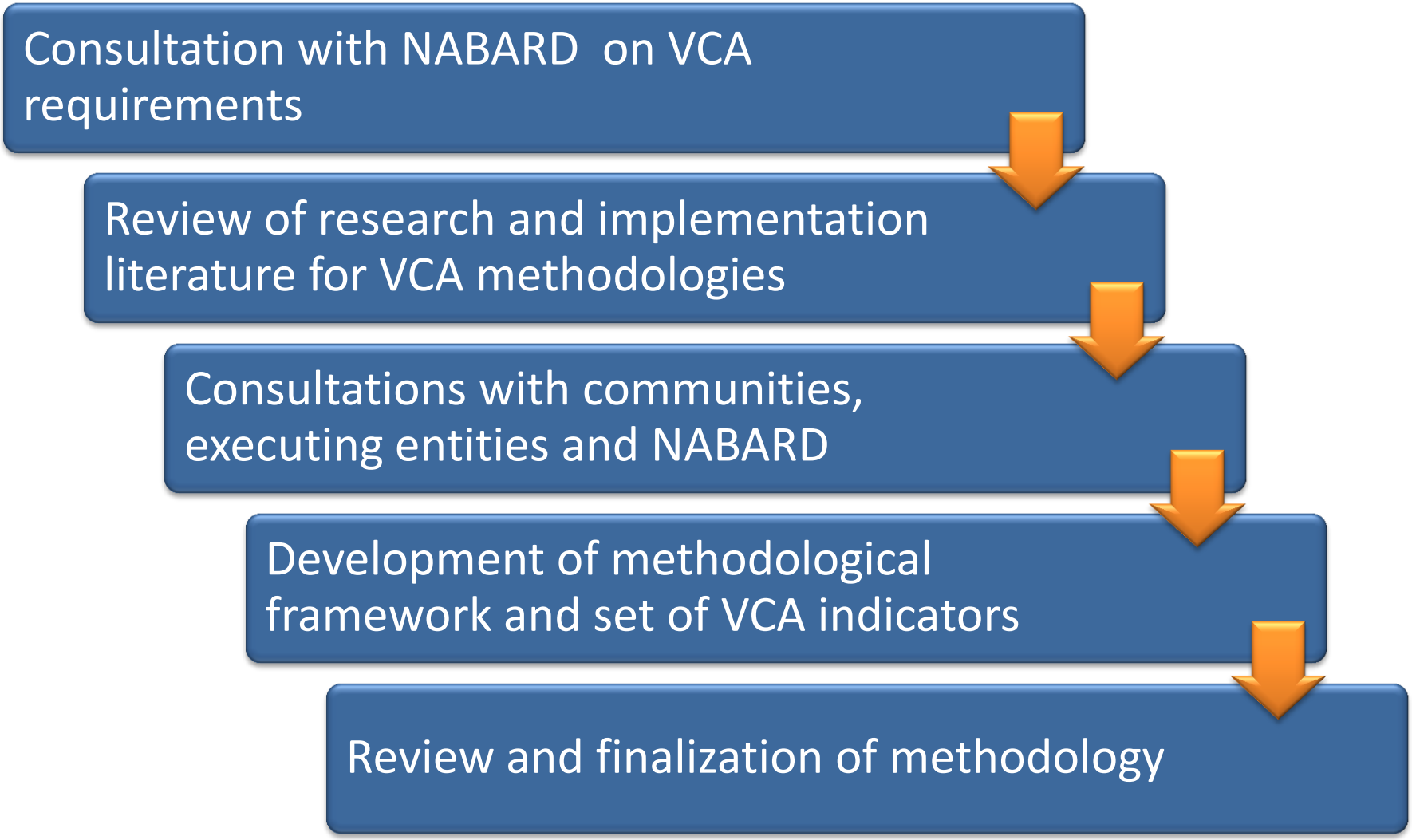
Refer to the Table 3 on methodologies employed in Indian context in the VCAI documentation

Common Findings from the Review

- Largely follows the vulnerability as a function of exposure, sensitivity and capacity
- Largely quantitative approaches but qualitative listing of vulnerabilities are also common particularly in small scale projects
- Advocates for participatory approaches and often employs participatory rural appraisal methodologies for identifying vulnerabilities
- Employs indicators for quantifying the exposure, sensitivity and capacity factors
- The concept of critical thresholds have been proposed but not been employed due to lack of clear boundary line and means of identifying thresholds
- Some have converted indicators into an index for better comprehension
- Often employed weights to convert indicators into an index
- The indicator and weights were obtained through stakeholder consultations

Developing Vulnerability Capacity Assessment Index (VCAI) for NABARD

Steps for Development of VCAI for NABARD



VCAI Methodology: Expectations from Adaptation Fund

- Adaptation Fund (AF) defines a project as a set of activities that are aimed at reducing the climate change vulnerabilities and increase the capacity of communities
- The AF gives specific stress for projects to address the vulnerabilities of the specific groups such as women, children, marginalized groups, displaced, indigenous etc.
- Apart from these broad underpinnings, there are no specific guidelines from AF on how to develop VCA methodologies leaving the approach to individual implementing entities

Nature of Adaptation Projects by NABARD

- Mostly focus on natural resource management
- Address the vulnerabilities found typically in rural and marginal areas
- Specific focus of projects has thus far has been on
  - agriculture,
  - agroforestry and mangroves,
  - animal husbandry and fisheries
  - water conservation practices
  - Other broad rural development approaches

How the Project Proposals Addressed the Vulnerabilities

- Largely qualitative discussion on vulnerabilities with focus on exposure related aspects than the sensitivities
- Not so clear identification of vulnerability assessment indicators, indices and methodologies
- Gaps in terms of lack of clear linkage between interventions identified and vulnerabilities discussed
- Vulnerability assessments have been proposed to be conducted as a part of the project implementation
- There is a clear gap in the capacity of executing entities to conduct vulnerability assessments

Vulnerabilities Identified by Some Specific Projects

Project	Vulnerabilities identified	Proposed activities to address vulnerabilities
Climate proofing of watershed development projects in the states of Tamil Nadu and Rajasthan	• Dependency on rain-fed farming • High poverty levels • Soil erosion • Degradation of irrigated lands • Water pollution • Over exploitation of forest stocks • Declining water table • Input intensive agriculture with mono-cropping • Climate variability and projected changes	• Soil and water conservation structures • Improved farming practices: Deep tillage, application of tank silt, nutrient management, change of cropping patterns and integrated farming systems • Agro-forestry and agro-horticulture • Micro-irrigation, energy efficient devices • Agro-meteorological observatory and crop insurance

Refer to the Table 1 in the documentation

VCAI Design Considerations

- **Simple:** The tool has to be simple keeping in view the capacity considerations of the stakeholders engaged in designing and implementing adaptation projects
- **Measurable:** The vulnerabilities have to me measured, desirably quantitatively, so as to provide a means of assessing the progress on the project time scale and beyond
- **Scalable:** The projects vary in scales, from local to state and national level and hence the tool should be flexible enough to scale to the required level
- **Comparable:** For the purpose of the NABARD as an executing agency, it is important that the vulnerability assessments from different projects be comparable. Hence, providing a basic minimum set of indicators that could be applicable in wide range of geographical and socio-economic conditions is essential for such comparisons at both generic and sectoral level.

Vulnerability and Capacity Assessment Index (VCAI)

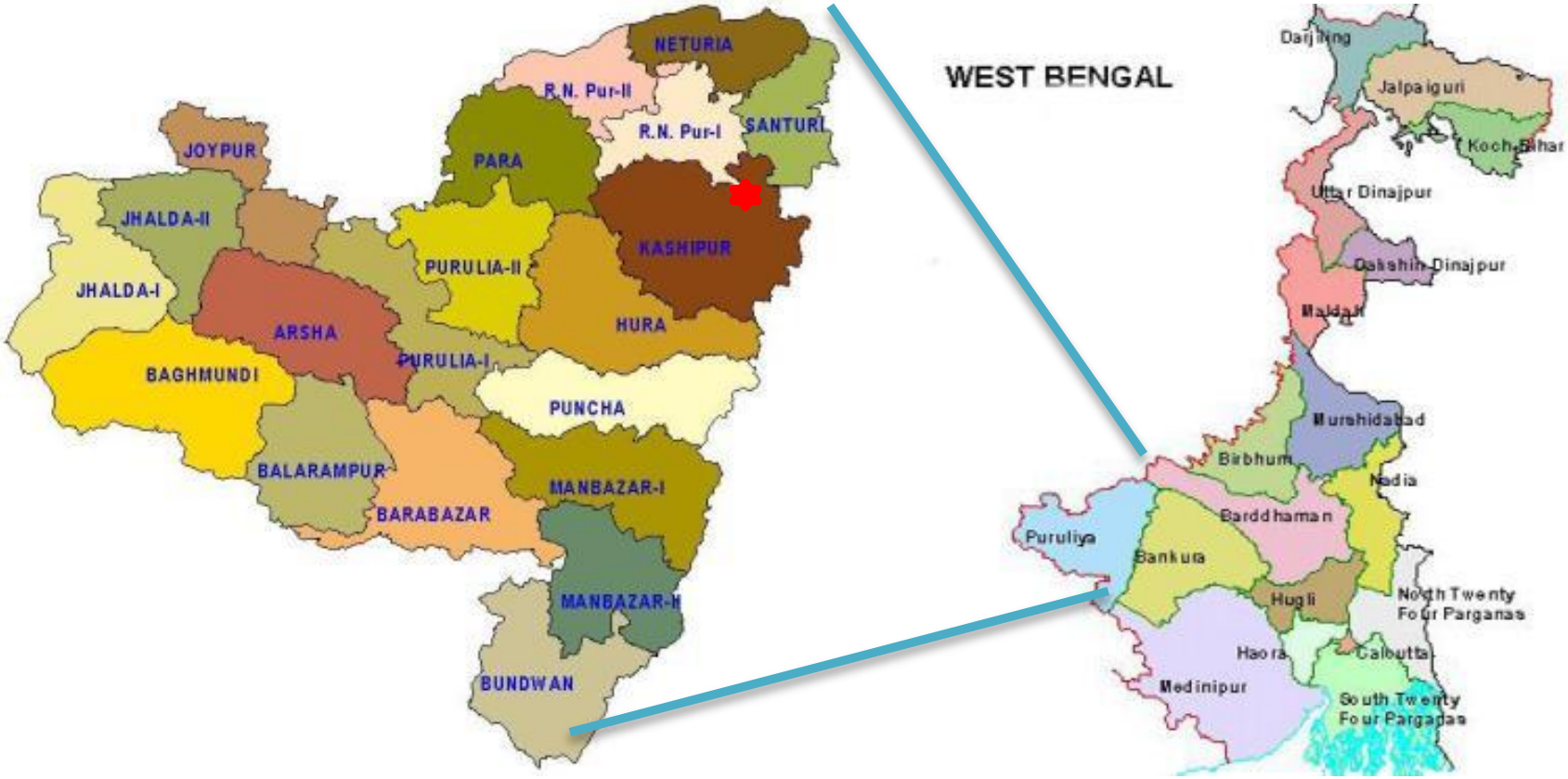
- **VCAI:** is a vulnerability and capacity assessment tool developed based on the general underlying concepts of vulnerability assessments discussed earlier.
- **The scope:** The scope of the Index is to measure the vulnerability at the project level. However, efforts have also been made to include some policy and institutional indicators to contextualize the project at the project location that is not in isolation with the larger policy and institutional enabling environment.
- **Interpretation of the output:** The index outputs a normalized maximum value of 1 and a minimum of 0 where 1 is maximum vulnerability and 0 is no vulnerability. The index outputs can be obtained for overall project location, sub-locations such as villages or a section of communities and sub-sector level such as food and agriculture, biodiversity and ecosystem services etc.

VCAI cont…

- It employs a quantitative methodology coupled with participatory consultative approaches for prioritizing vulnerability indicators and their weightages
- Adapts thresholds concept for normalizing the data, advocates a broad range of threshold values rather than a single value within which the value of indicators may fall in the real world.
- Provides ability to assess VCA at specific and aggregate geographical and sectoral levels
- Provides ability to compare projects in terms of their performance for M&E purposes as it accommodates a generic set of indicators that are common to all the sectors included in the tool
- All indicators and weights are fixed, provisionally, for each version of the methodology. However, it also provides ability to chose location-specific indicators.

Identification of VCA Indicators

- Case study in Purulia District of West Bengal in cooperation with DRCSC



Steps involved in indicator identification

- **Step I: Discussion on demographic background**
- **Step II: Hazard identification and prioritization**
- **Step III: Identification of vulnerability indicators**
  - **Exposure**
  - **Sensitivity**
  - **Capacity**

Computation of VCAI

Vulnerability and Capacity Assessment Index (VCAI) = (E-S)+C

Where

E is exposure value obtained by average of the exposure indicators

S is the sensitivity value obtained by average of sensitivity indicators

C is the capacity value obtained by average of capacity indicators

Indicators Framework

- The VCAI tool comprises of several exposure, sensitivity and capacity indicators categorized into generic and specific sectors.
- All indicator values are normalized before they are combined in the form of an index

Sector/Category	Current No of Indicators in VCAI
Generic	38
Food and Agriculture	21
Water	21
Land	13
Fisheries and Animal Husbandry	13
Biodiversity and Ecosystem Services	29

Show the Excel Sheet

Normalization of Indicator Values for VCAI

The indicator values are to be normalized, for they differ in units, to bring them to a single scale.

Normalized indicator value $$z_i = \frac{x_i - T_{\min}(x)}{T_{\max}(x) - T_{\min}(x)}$$

Where

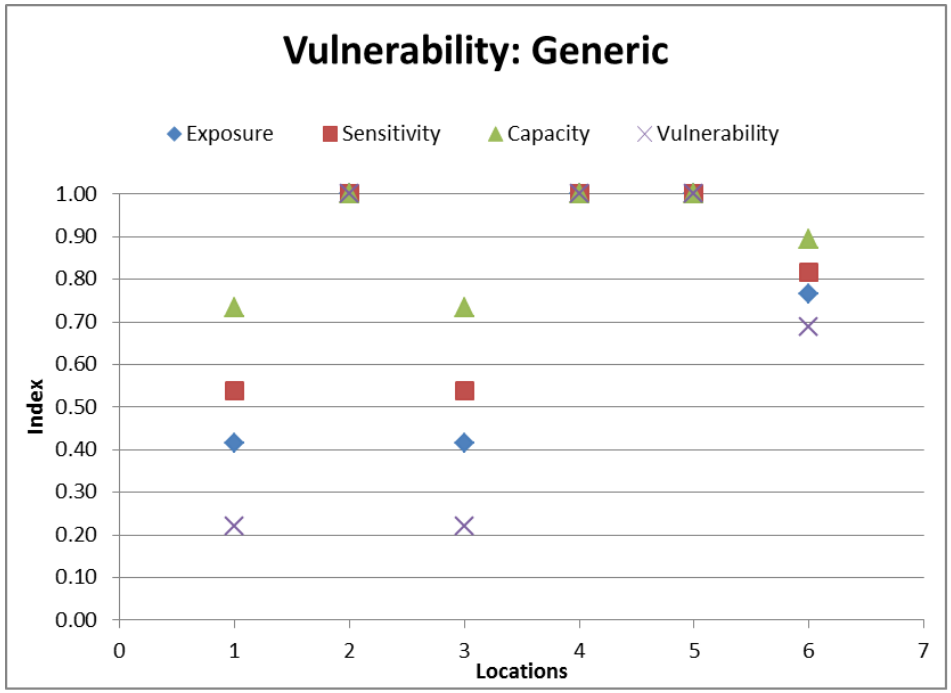
x_i is value of the index

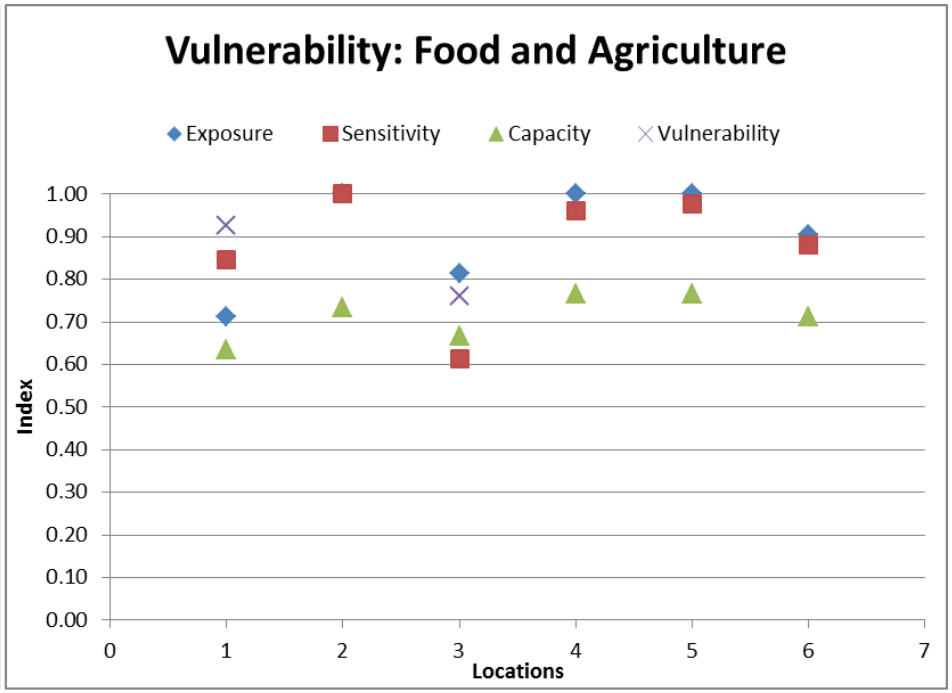
T_{min} is minimum threshold value of the index xi

T_{max} is maximum threshold value of the index xi

VCAI Output

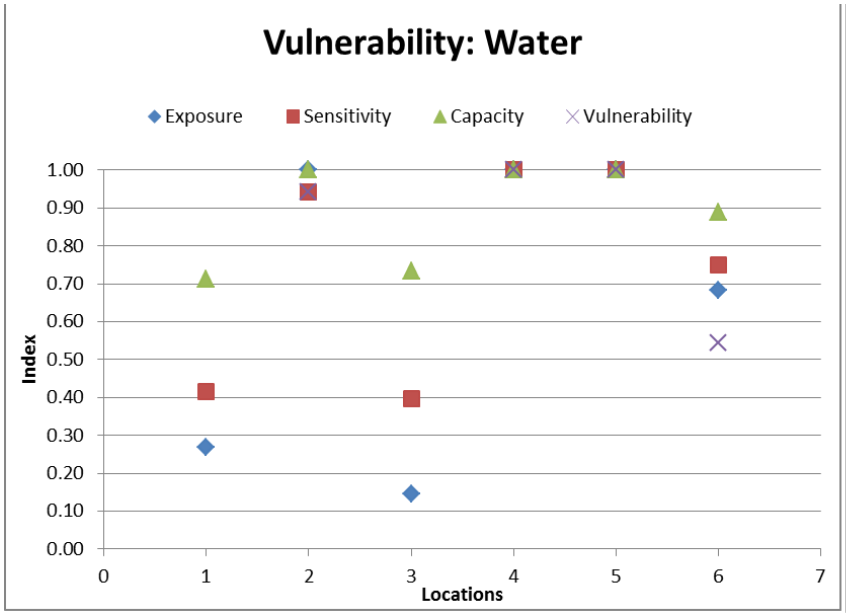
- The tool provides a graphical output to help the user compare different geographic locations on sectoral and aggregate levels

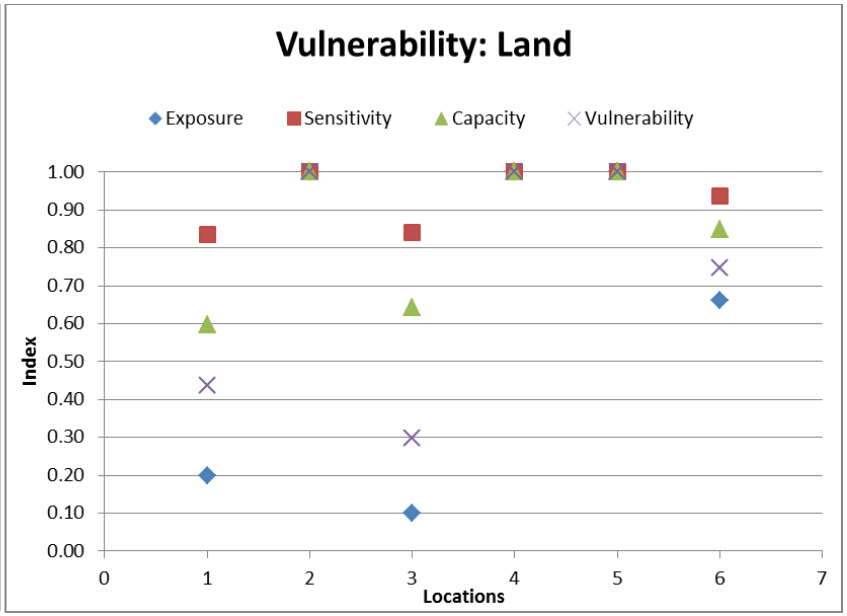


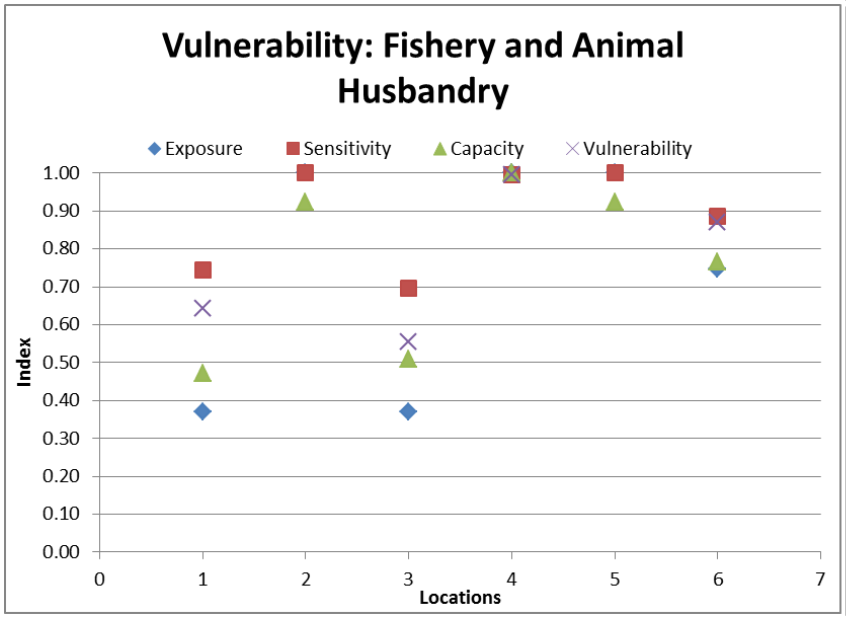


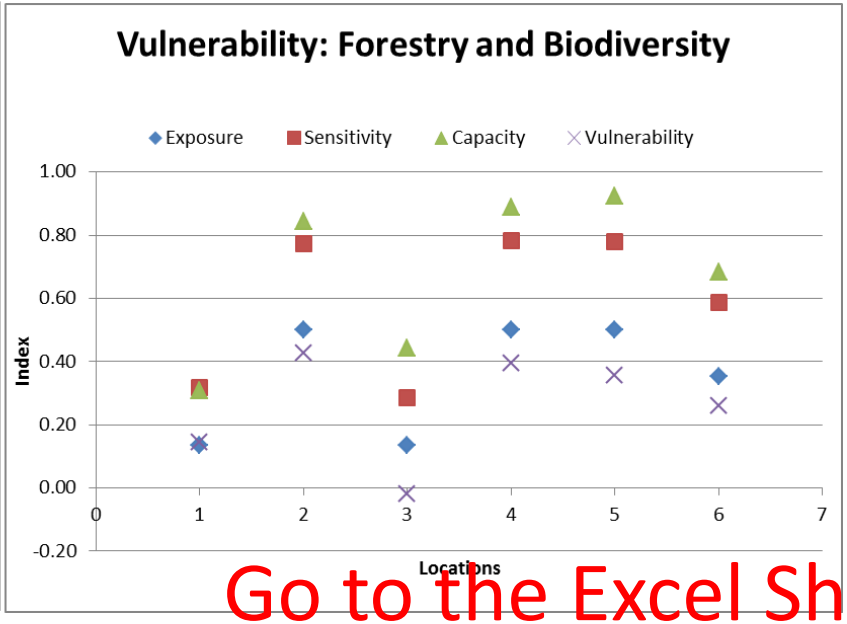
Source: Author

VCAI Output







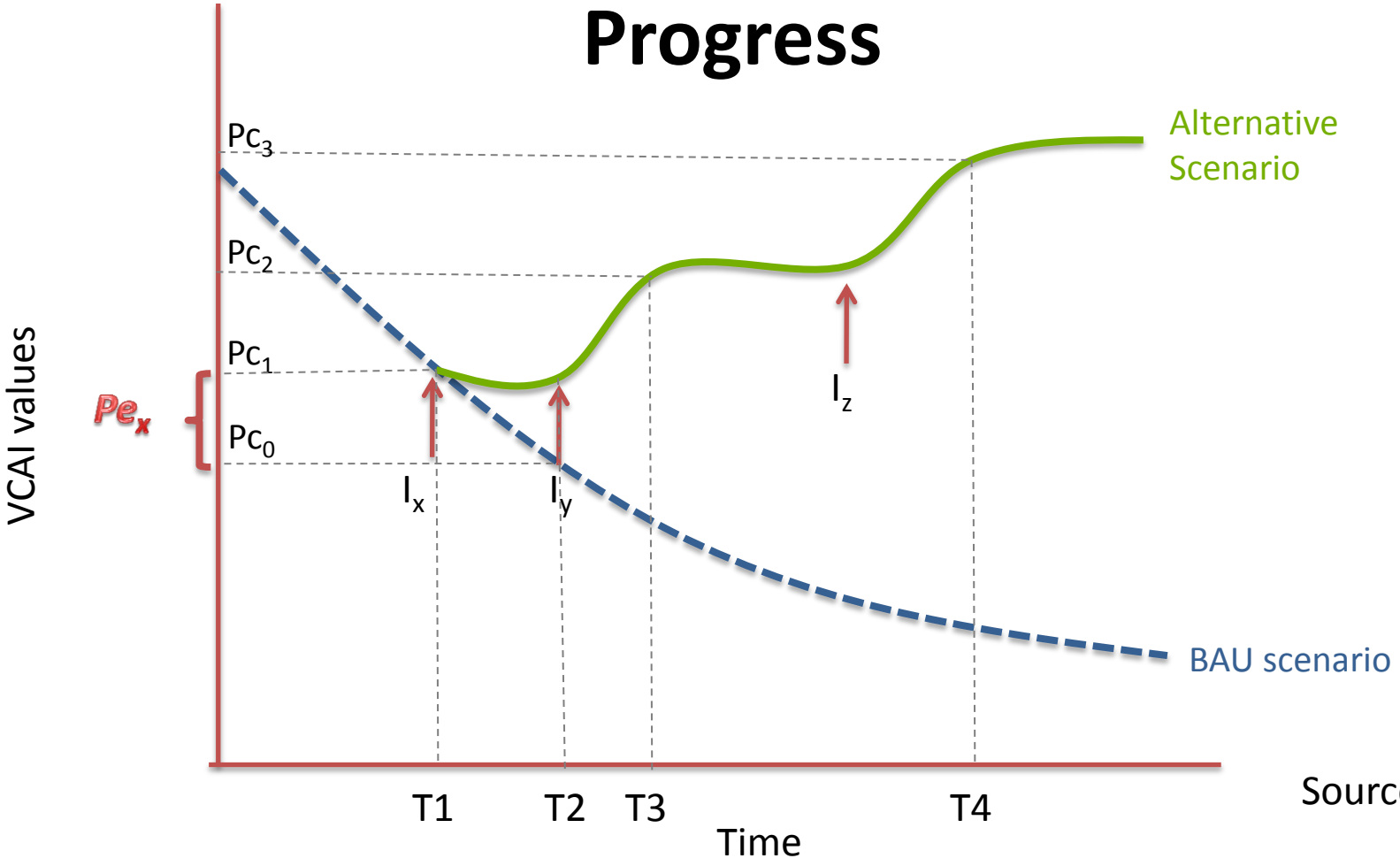


Go to the Excel Sheet

Steps Involved in Implementing VCAI

- **Step I:** Random sample of the villages where the vulnerability assessment has to be conducted
- **Step II:** Fix the baseline through consultations among project stakeholders against which the project has to be evaluated
- **Step III:** Collection of data for indicators
  - Conduct participatory rural appraisal sessions with communities
    - To introduce the purpose of the project to the communities
    - To familiarize the vulnerability indicators with communities
    - To obtain values for the indicators
  - Consult literature/published data for those indicators for which there is no values could be obtained from the PRAs
- **Step IV:** Input the data into the excel sheet
- **Step V:** Submit the excel data on regular intervals (annual) for monitoring and evaluation purposes

Using VCAI for Assessing the Project Progress



Source: Author

$$Pe_x = Pc_1 - Pc_0$$

Where:

Pe_x: Effectiveness of project x;

Pc_0, Pc_1: VCAI values at times T1 and T2

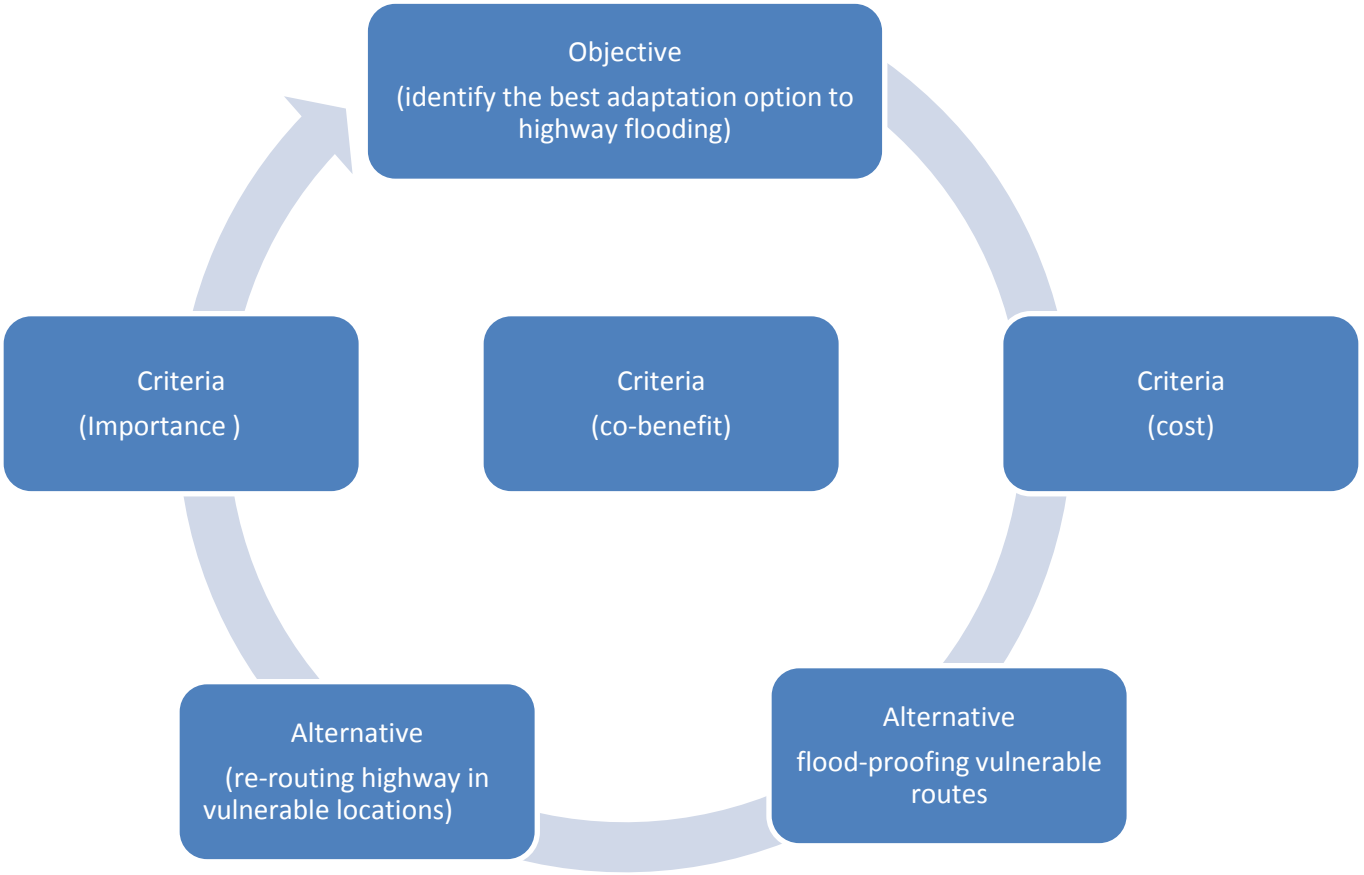
Ix, Iy, Iz: Project interventions at time T1, T2 and T3 respectively

Further Steps

- Obtain sufficient number of responses from Executing Entities for indicator weights, sector weights and critical thresholds
- Finalize the excel tool after fixing the indicators and weights
- Finalize the documentation after considering the review remarks
- Future possible collaboration:
  - Conducting a training session on VCAI
  - Prioritization of adaptation practices using multi-criteria methodologies

Prioritizing Adaptation Practices

Decision Hierarchy is an Inherent Problem of Adaptation Decision Making



Adaptation as a Multi-Criteria Problem

- **Appropriate decision-making at the community level is critical for adaptation**
  - Adaptation is highly context-specific and no one-size-fits-all.
  - Adaptation require engagement of different stakeholders that have different criteria, access to choices, expertise etc.
- **But how do communities decide?**
  - Community members have varying understanding on climate change and adaptation measures
  - What criteria underlies their decisions?
  - What factors influence their decisions?

Tools for Decision Making

Tool	Pros	Cons
Cost-benefit analysis	Easy quantitative comparison across alternative adaptation options	Difficult to get cost and benefit data for social parameters.
Multi criteria analysis	Could rank different adaptation options on considering multiple criteria	Pair-wise comparison may become so large (n(n-1)/2) that it becomes a lengthy task.

Multi-Criteria Decision Making (MCDM)

- Other tools not effective and robust enough
- Growing use in natural resources management
- Preferred method to prioritize and select adaptation policies and measures (UN)
- NAPA preparation process - Identifying high priority adaptation projects: Vanuatu, Bhutan, Mali, Senegal, Cape Verde

MCA Method	Criteria	Region	Decision problem	Field of application	Reference
Analytic Hierarchy Process (AHP)	Maximization of net benefit, maximization of area, resources availability	Thailand	Selection of the best irrigation plan	Irrigation management	Mainuddin et al. 1997
AHP, PROMETHEE	Cost, economic, social, environmental factors.	Greece	Selection of the best water project	Water management	Anagnostopoulos 2005.
AHP	Rainfall, elevation, water network, road network, nectar, pollen	Malaysia	Determining land suitability of bee zones.	Agriculture/land suitability	Maris et al. 2008
AHP	Conservation value, business investment, recreation visitor days, extent of river red gum, number of bird species	Australia	Identification of the best planning option in wetland management	Wetland management	Herath (2004)
Compromising programming	Cost, public appraisal, political impact quantity of water, health impact, flexibility, water demand control, time of water shortage, population impact	Iran	Selecting water and wastewater management options	Water management	Abrishamchi et al (2005)
AHP	Environmental performance, Political acceptability, Feasibility of implementation (sub-criteria, direction contribution to GHG emissions, indirect environmental effects, cost efficiency.	Trinidad and Tobago	Finding the most appropriate policy instrument for GHG-emission mitigation	Climate change	Blechinger and Shah (2010)

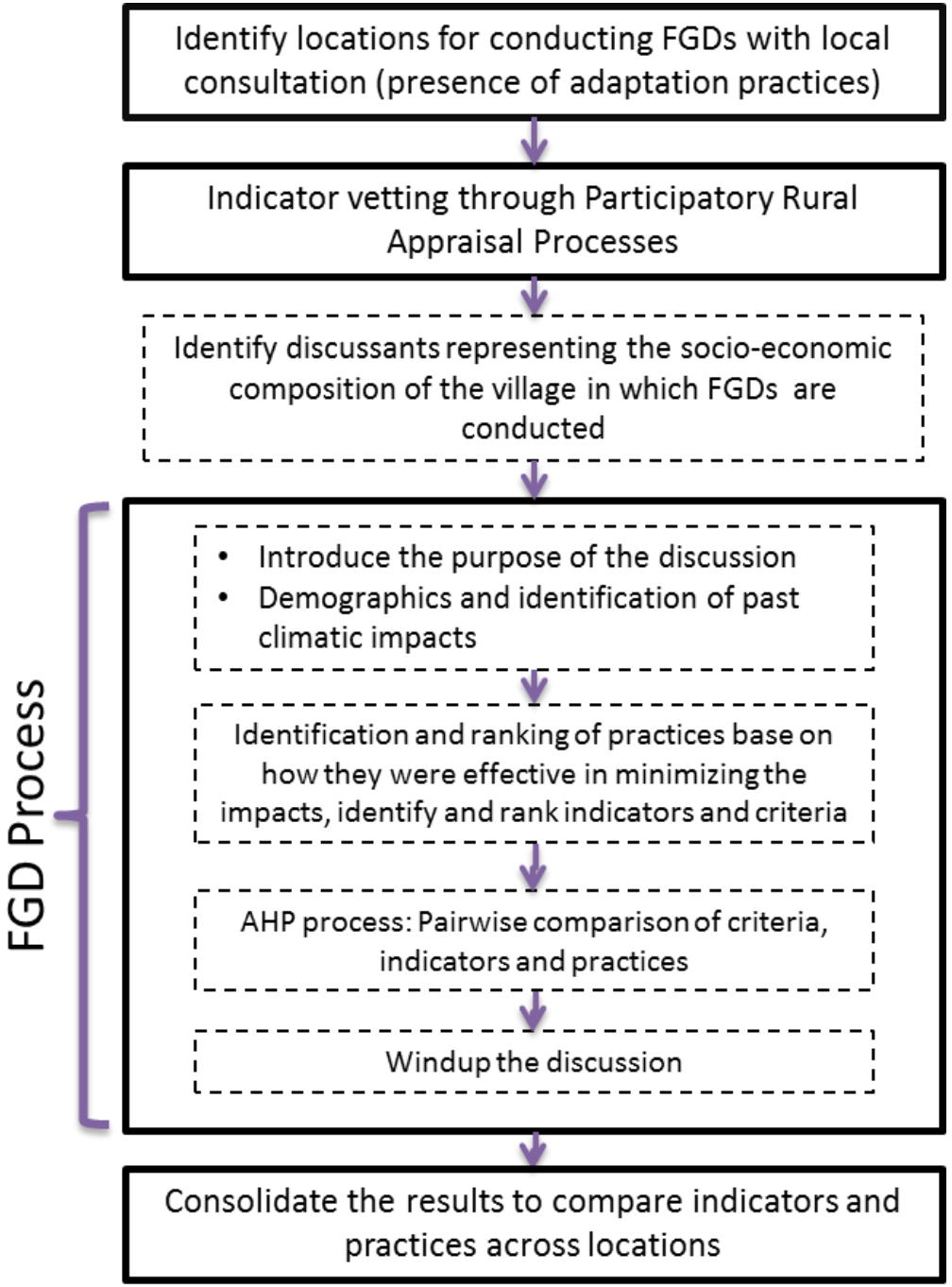
AHP - Analytic Hierarchy Process

- Widely used MCA method
  - Resource allocation
  - Strategic planning
  - Project/risk management
- **Basic Steps:**
- Step 1: Define objective
- Step 2: Structure elements in criteria, sub-criteria, alternatives.
- Step 3: Make a pair-wise comparison of elements in each group
- Step 4: Calculate weighting and consistency ratio
- Step 5: Evaluate alternatives according to weighting

Analytical Hierarchy Process (AHP)

- AHP allows users to employ multiple criteria to assess and compare various alternatives
- Each criteria is weighed (each criteria has different importance)
- The weight of each criteria is determined by pairwise ranking process (comparing two criteria to see which one is more important)

Steps Involved in AHP through FGDs in a Project Context

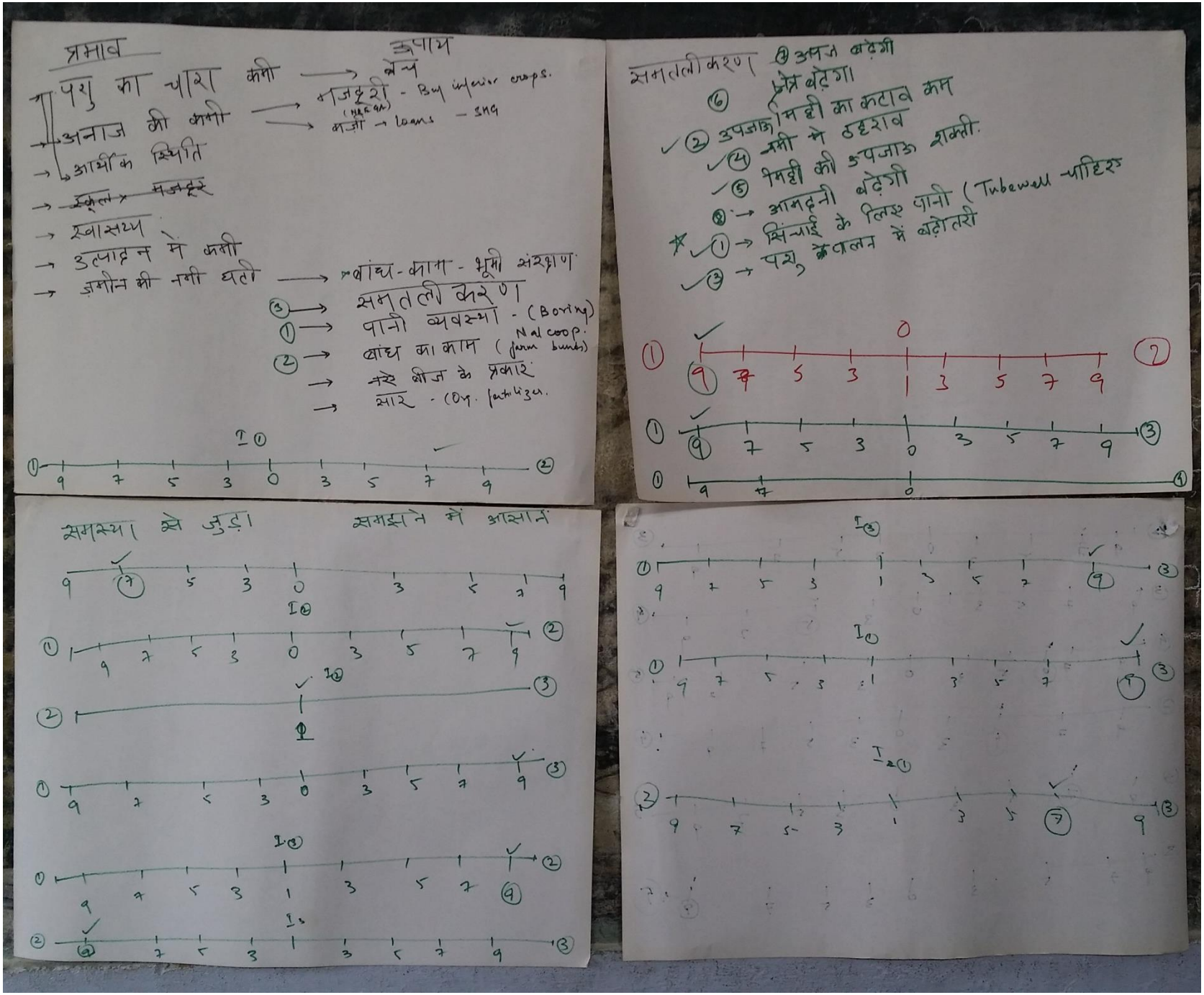


Weighing between different options

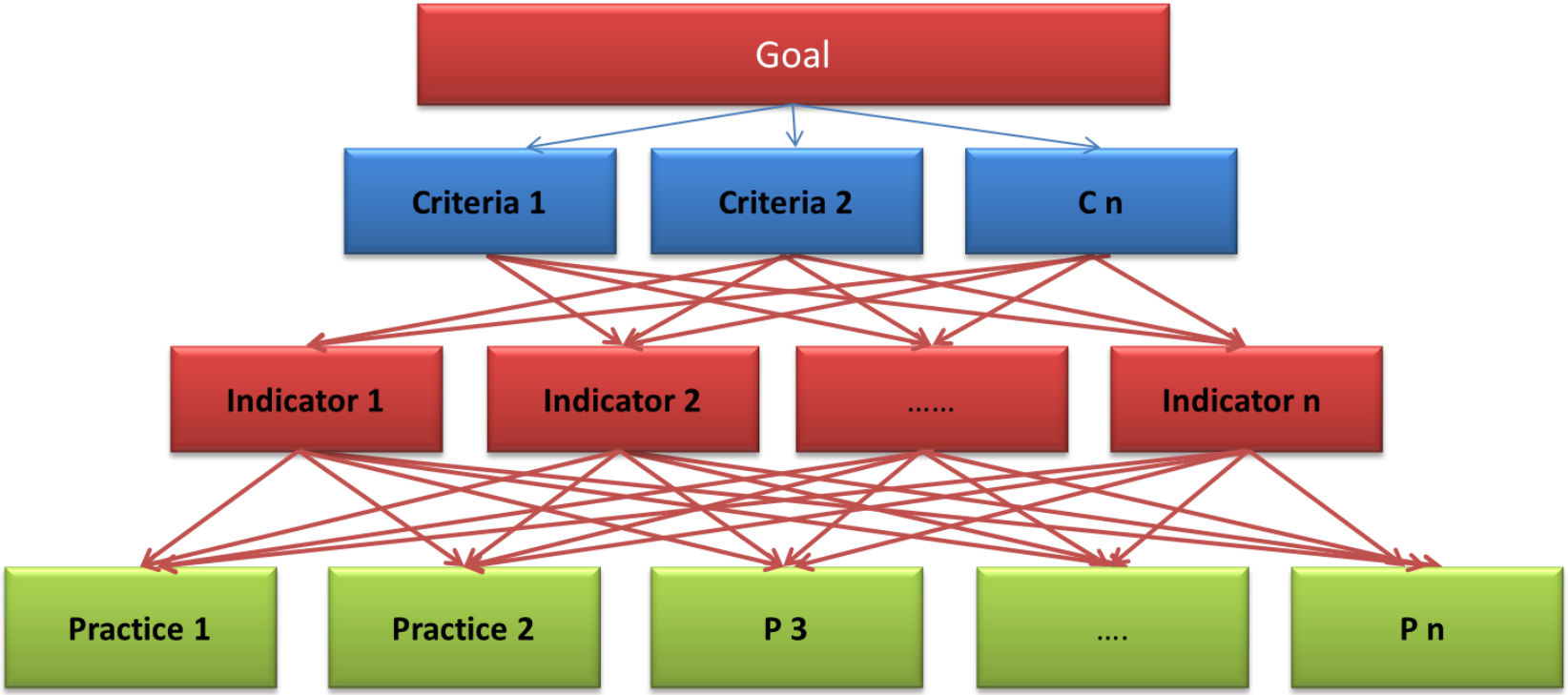
Saaty's Fundamental Scale of Judgment

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance	Judgment slightly favors one criteria over another
5	Strong importance	Judgment strongly favors one criteria over another
7	Very strong importance	A criteria is favored very strongly over another
9	Extreme importance	Judgment favoring a criteria is of the highest possible order of affirmation

Field surveys

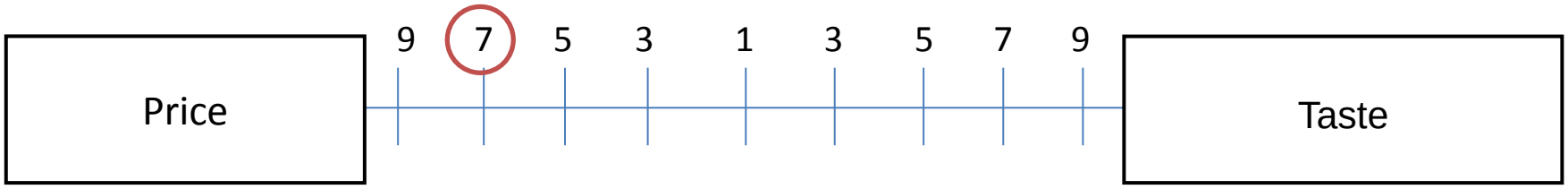


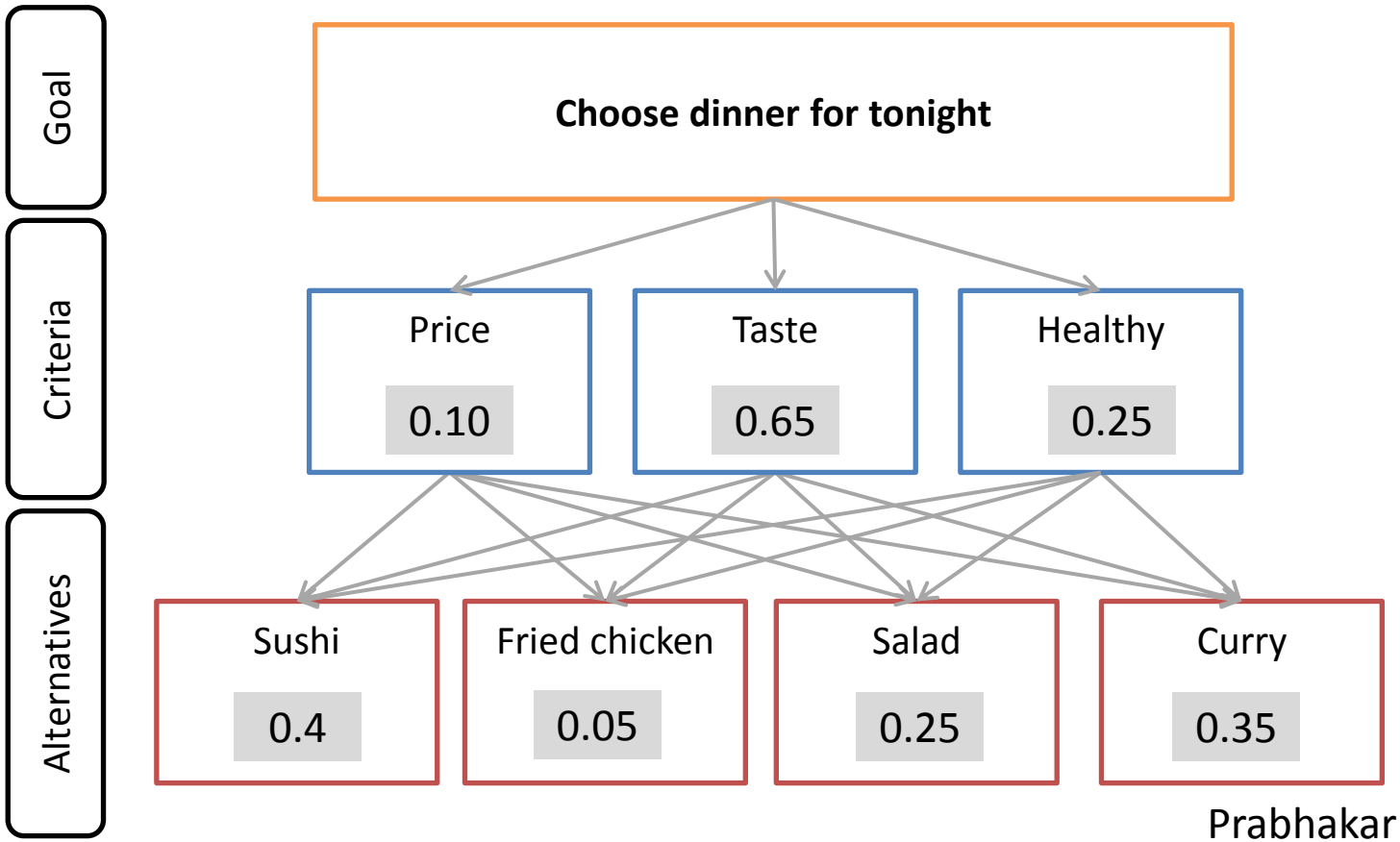
Pictorial Representation of hierarchical nature of criteria, indicators and practices in AHP methodology



AHP application: An example

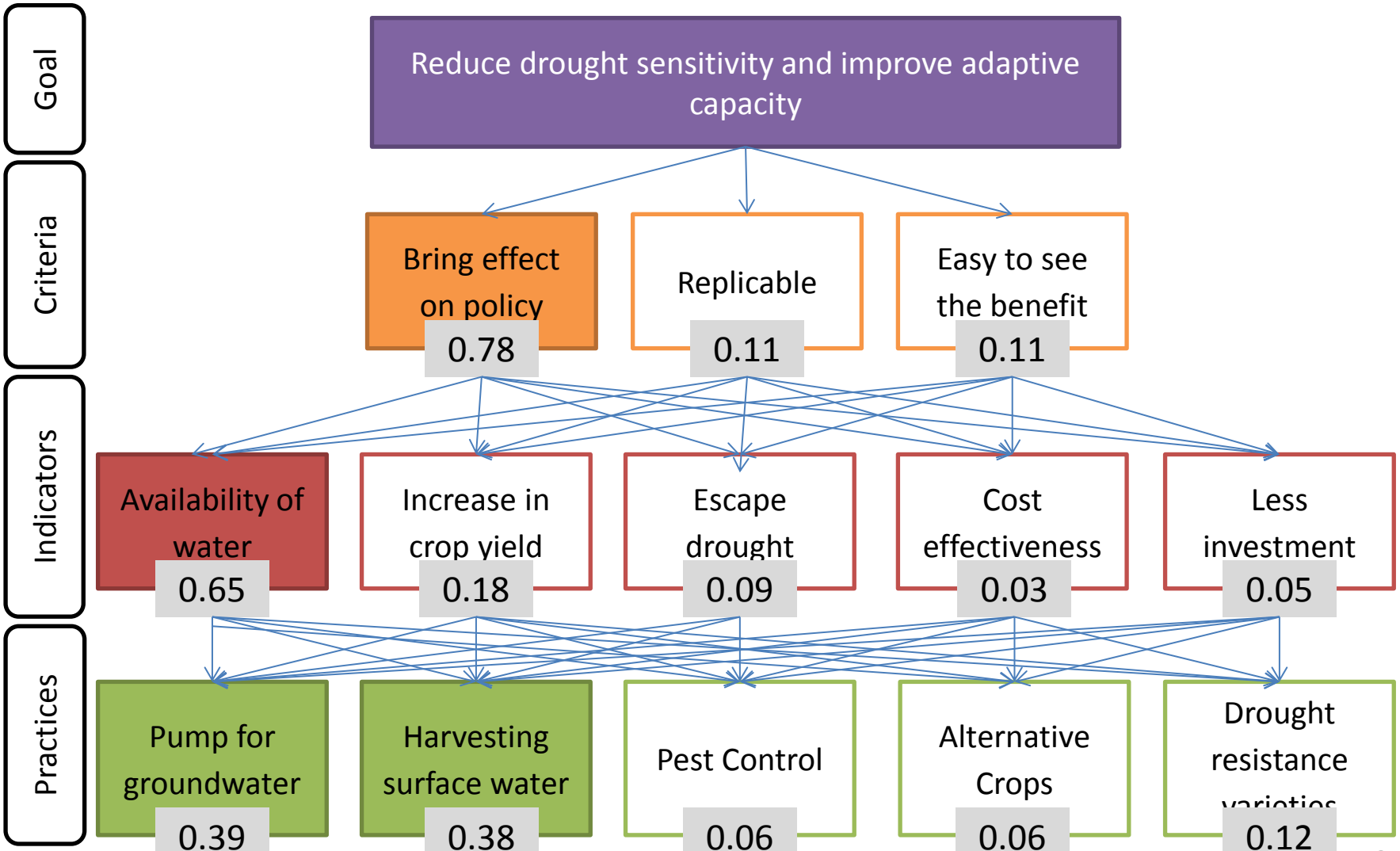
e.g. How to choose from a restaurant menu?





Prabhakar et al., 2014

Case 1: Nepal – drought -male



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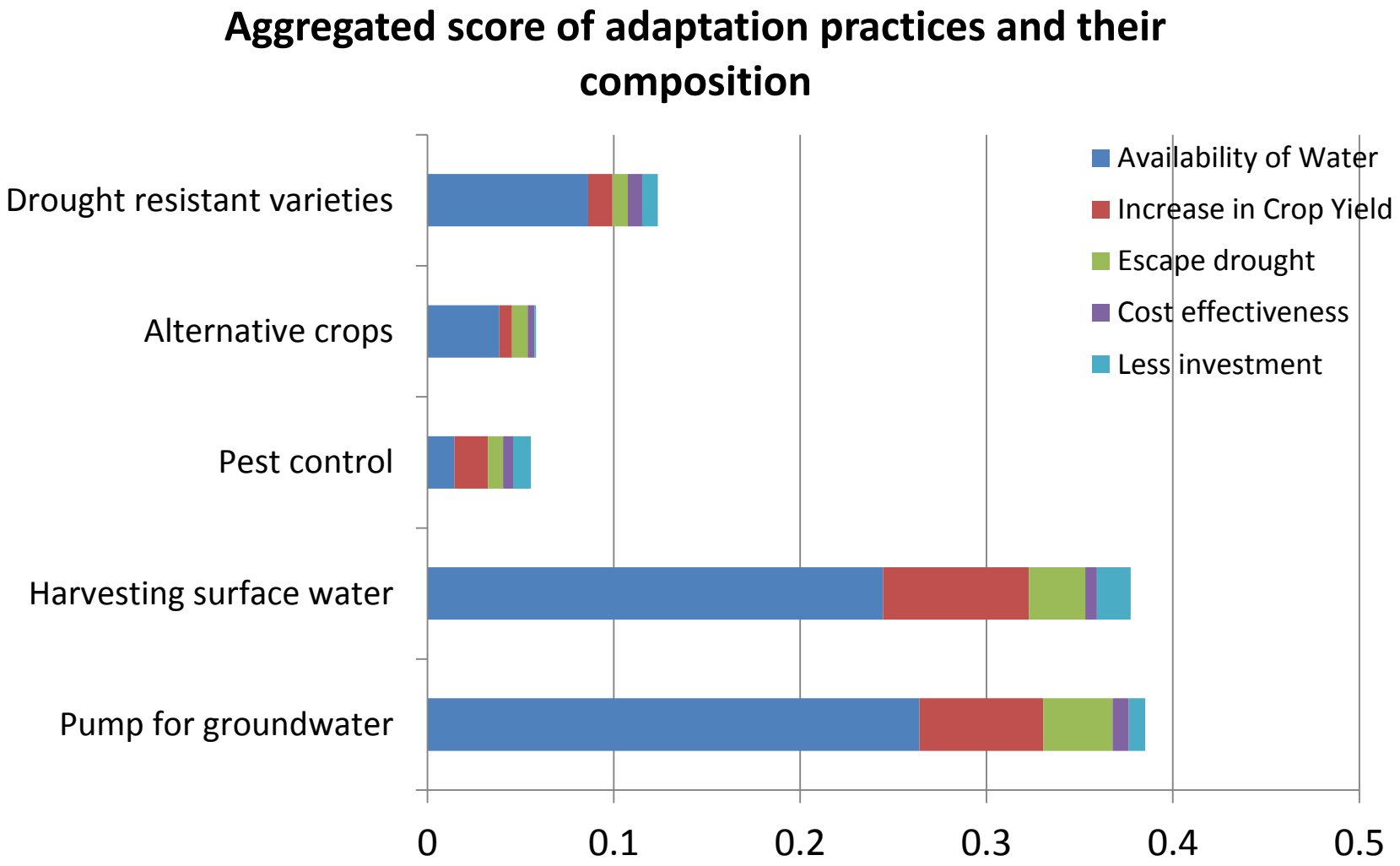
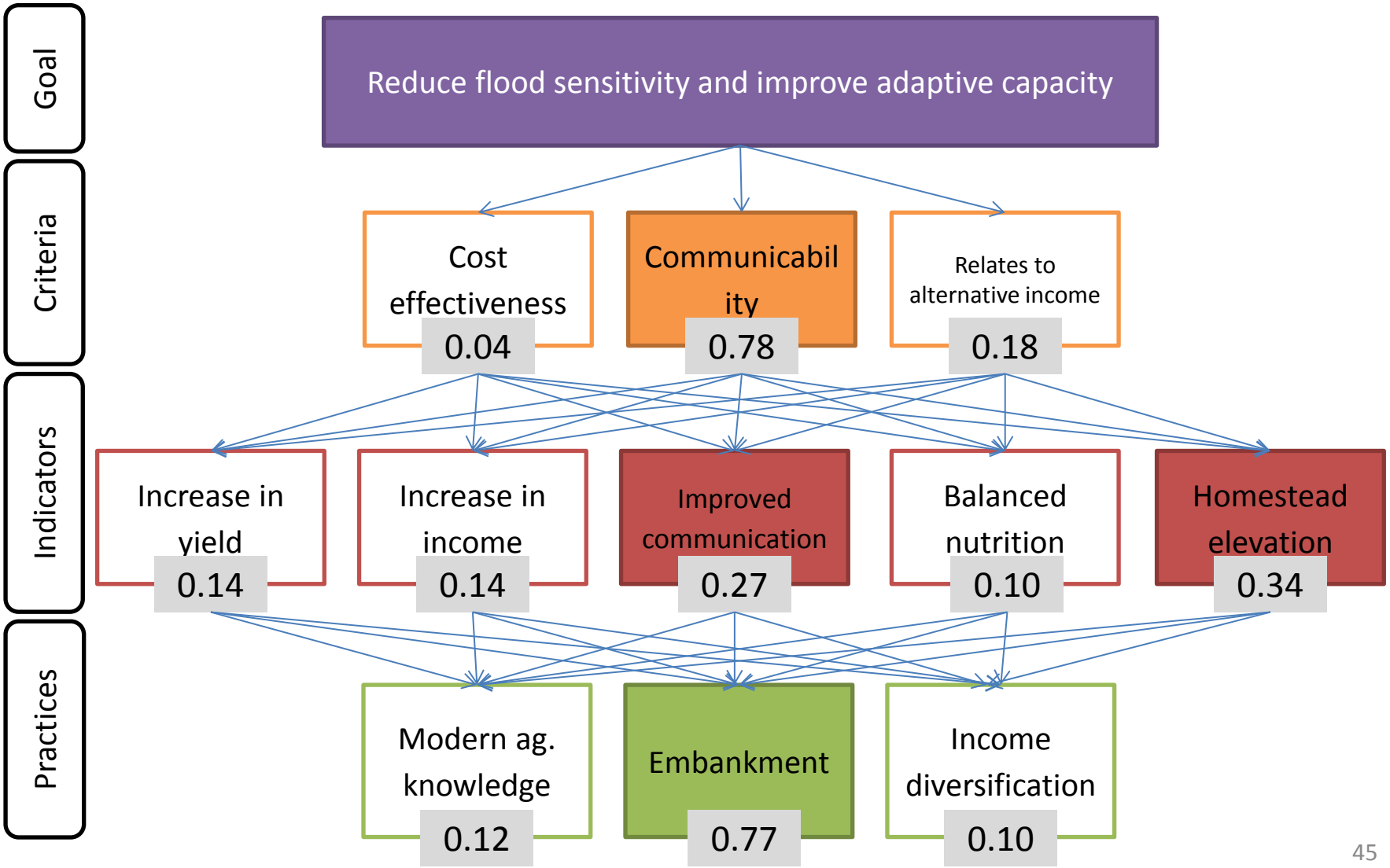


Prabhakar et al., 2014

Case 2: Bangladesh – flood-female



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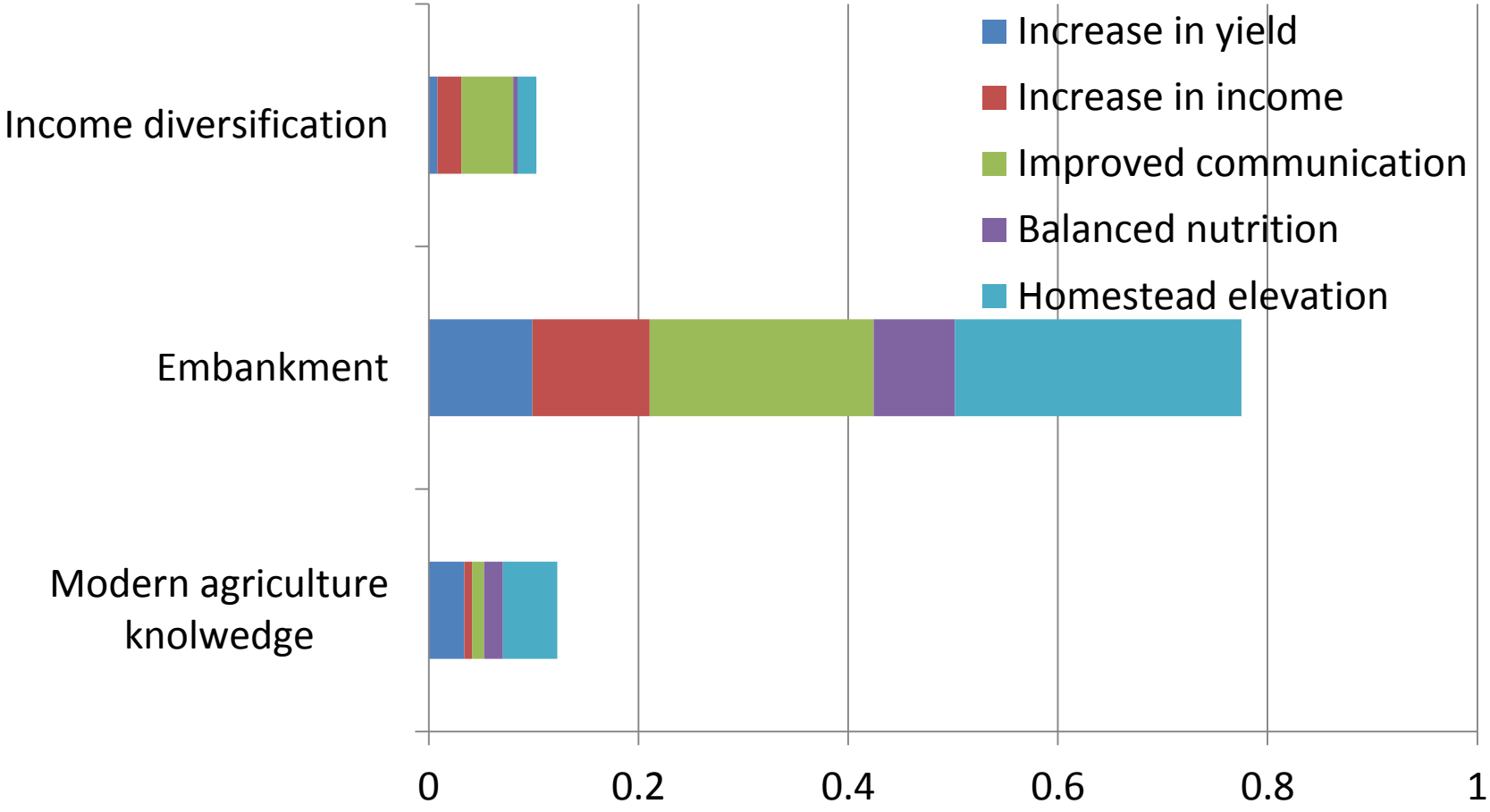

Prabhakar et al., 2014

Available Tools

- Super decisions software
- Excel based tools

Show

Super Decisions Software

Excel sheet (K. D. Goepel Version 12.08.2013)

Thank You!

For more information, please contact: sivapuram.prabhakar@gmail.com