CIA STEP 4: ASSESS CUMULATIVE IMPACTS ON VECS

METHODS

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CIA METHODS

Objectives:

- Identify potential environmental and social impacts and risks.
- Assess expected impacts as the potential change in condition of the VEC (i.e., viability, sustainability).
- Identify any potential additive, countervailing, masking, and/or synergistic effects.

Questions to answer:

- What are the key potential impacts and risks that could affect the long-term sustainability and/or viability of the VEC?
- Are there known or predictable cause-effect relationships?
- Can these impacts and risks interact with each other?

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CIA METHODS

A wide range of methods have been and can be used to assess the impacts of the multiple developments on VECs and evaluate different scenarios

Methods range from simple spreadsheets or spatial GIS analysis, to multifactor models

See page 43 of CIA manual

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CIA DATA

Analysis and Models are only as good as the data that go into them

CIA DATA SOURCES

- Much of the needed data should be available from project ESIAs
- Additional data from government, NGOs, and other stakeholders such as socio-economic, future project plans, etc.
- Some additional data collection may be needed in the field

EXAMPLE: KEY DATA NEEDED FOR AQUATIC CIA

- Fish distribution and abundance, or suitable habitat as proxy
- Macroinvertebrate and periphyton distribution and abundance
- Terrestrial biodiversity and its significance at landscape level
- Sediment flows and expected trapping by HPP dams
- Community dependence on ecosystem services, e.g. fishing and sediment mining
- Plans for development of hydropower and irrigation projects

REMINDER: CIA IS FUTURES ORIENTED

CIA analysis is futures oriented. The impact of the project is not assessed as the difference between the expected future condition of VECs and that of a past baseline condition.

It is assessed as the difference between the estimated future condition of VECs in the context of the stresses imposed by all other sources (projects and natural environmental drivers) and the estimated VEC condition in the context of the future baseline plus the development under evaluation.

Of concern is not just estimation of the development's impact, but estimation of the future condition of VECs in the context of all stresses—which is the cumulative impact—and can be evaluated in reference to an established threshold level of acceptable condition, if known, or in reference to a past baseline.

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TYPES OF METHODS FOR CIA

- Conceptual modeling, pathways, network analysis
- Cost-benefit analysis
- Decision support systems (eg. EFlows)
- Expert Opinion
- GIS analysis
- Habitat modeling
- Information compilation with simple checklists, or more complex layered or matrix formats
- Indicators and indices of VEC condition
- Landscape modeling
- Population viability analysis
- Quantitative and/or simulation modeling, including spatially explicit GIS-based models
- Scenario analysis
- Sustainability appraisal
- Thresholds

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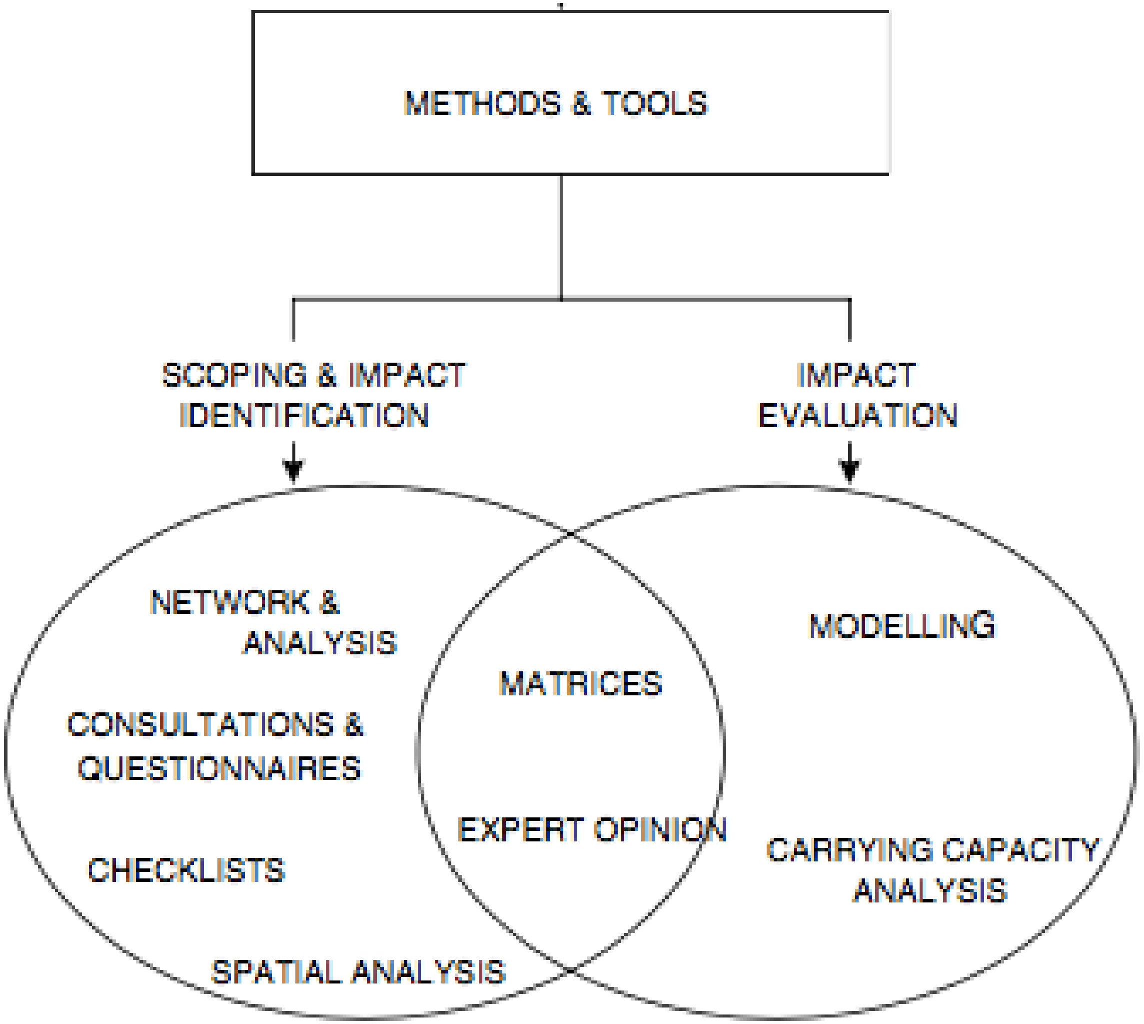
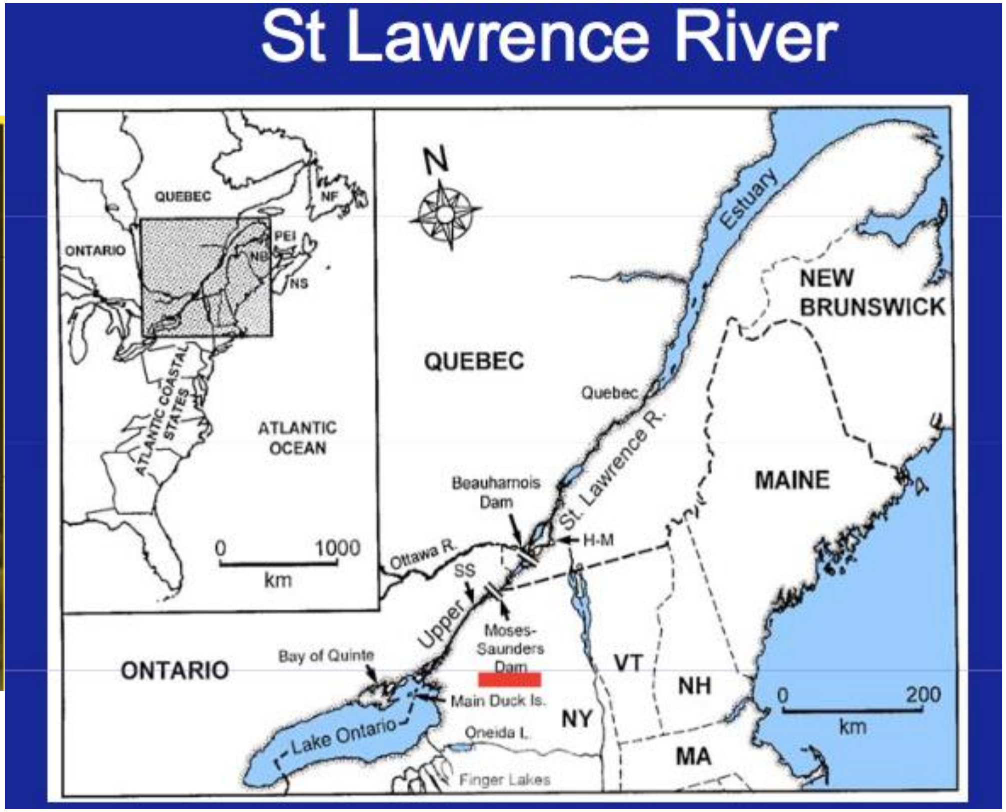
COMBINATION OF METHODS



CIA EXAMPLE: AMERICAN EEL



Source: Ontario Ministry of Natural Resources.

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CIA EXAMPLE: METRICS AND SPREADSHEET MODEL

VEC	Metric	Data Available and sources	Data Gap	Method
American Eel	% of adult eel population surviving through 11 HPPs to spawning grounds	Satellite imagery, Data from literature for similar sized HPPs	No field data on eel habitat so modeled area (ha) and % of suitable eel habitat between HPPs, Need mortality rate through HPPs	Quantitative Spreadsheet Model

CIA EXAMPLE: WIND FARM IN JORDAN

CATEGORY	SPECIES NAME	SPECIES SCIENTIFIC NAME	UNIT OF ANALYSIS	POPULATION ESTIMATE SOURCE	POPULATION ESTIMATE (NO. OF INDIVIDUALS)	IUCN CONSERVATION STATUS (GLOBAL RATING FOR CATEGORY 1, REGIONAL RATING FOR CATEGORY 2)	DEMOGRAPHIC PARAMETERS				
							SOURCE	AGE AT FIRST BREEDING	ANNUAL ADULT SURVIVAL (%)	RECOVERY FACTOR USED IN PBR	PBR LEVEL ESTIMATE, ANNUAL NO. OF FATALITIES
Category 1. MSB Bird Populations	Egyptian vulture	*Neophron percnopterus*	Flyway population	Porter, 2005	1,200	EN	Sanz-Aguilar et al., 2015 (Spain)	5	93%	0.1	5.2
	Steppe eagle[a]	*Aquila nipalensis*	Flyway population	Porter, 2005	76,600	EN	Katzner et al., 2006 (Kazakhstan)	4	92%	0.1	395
	Eastern imperial eagle	*Aquila heliaca*	Flyway population	Porter, 2005	556	VU	Katzner et al., 2006 (Kazakhstan)	4	92%	0.1	2.9
	Booted eagle[b]	*Hieraaetus pennatus*	Flyway population	Porter, 2005	2,000	LC	Newton, Davis, and Davis, 1989	4	96%	1	79
Category 2. Resident or Summer Breeding Raptor Populations	Short-toed Snake-eagle[b]	*Circaetus gallicus*	National population	Expert review	100	VU	Newton, Davis, and Davis, 1989	4	96%	0.1	0.4
	Griffon vulture	*Gyps fulvus*	Biogeo-graphic population	Expert review[c]	86	EN	Gouar et al., 2008 (France)	4	97%	0.1	0.3
	Golden eagle	*Aquila chrysaetos*	National population	Expert review	2	EN	No PBR analysis conducted. National population size estimate: small.				
	Verreaux's eagle	*Aquila verreauxii*	National population	Expert review	2	EN	No PBR analysis conducted. National population size estimate: small.				
	Bonelli's eagle	*Aquila fasciata*	National population	Expert review	22	LC	Hernández-Matías et al., 2011 (France)	4	91%	1	1.2
	Long-legged buzzard[d]	*Buteo rufinus*	National population	Expert review	200	LC	Kenward et al., 2000 (UK)	3	90%	1	14
	Lesser kestrel	*Falco naumanni*	National population	Expert review	200	NT	Hiraldo et al., 1996 (Spain)	2	71%	0.3	8.7

Source: IFC 2017.

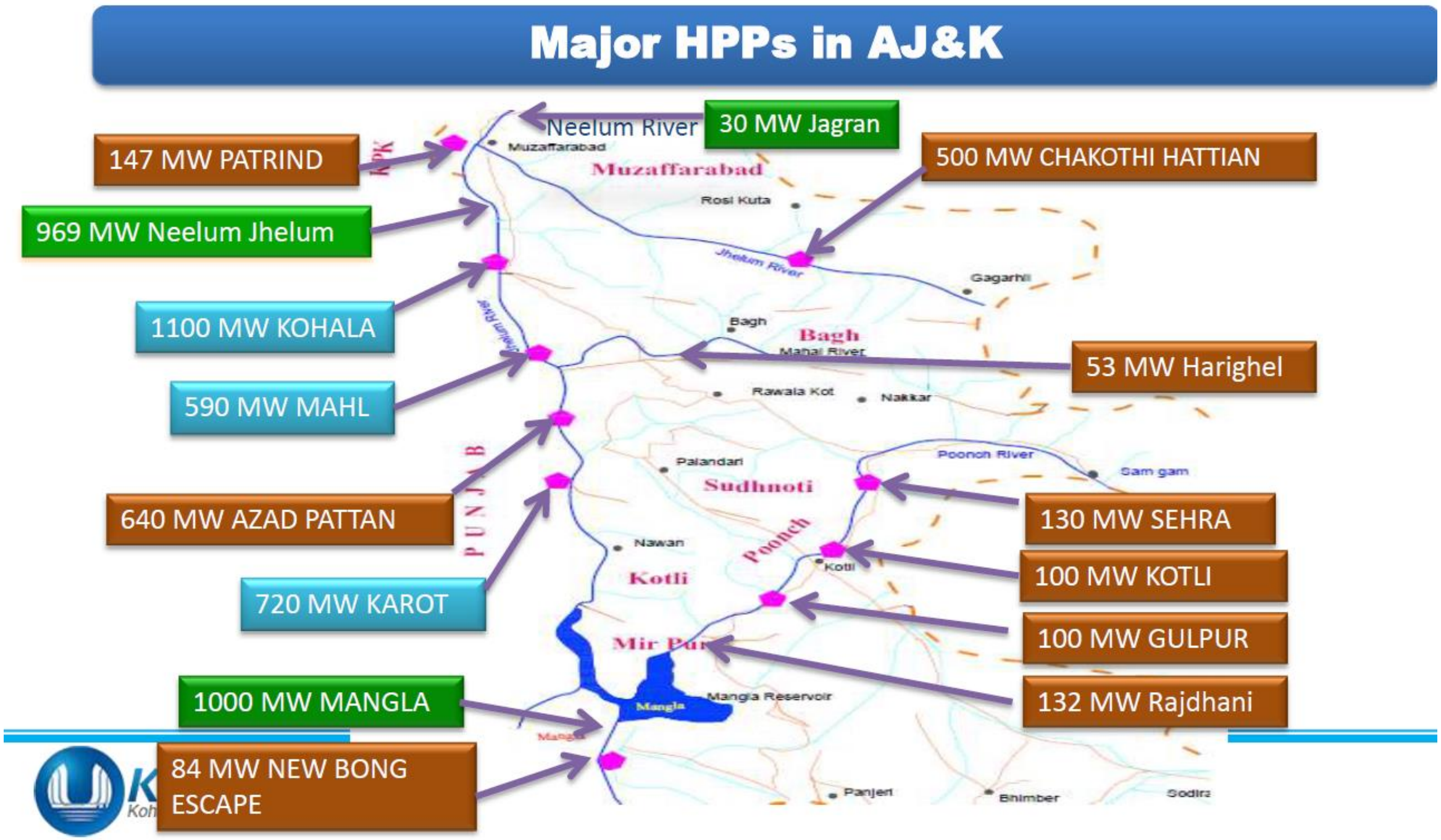
CIA EXAMPLE: WIND FARM CIA IN JORDAN

Setting Thresholds to detect significant impacts on vultures

TABLE 26. PRIORITY BIRD VEC (CATEGORY 2 RESIDENT AND SUMMER BREEDING RAPTOR POPULATIONS)—GRIFFON VULTURE (*GYPS FULVUS*): REVIEW OF CEA STEPS 1 TO 3 AND RESULTS OF STEP 4 IDENTIFYING THRESHOLDS

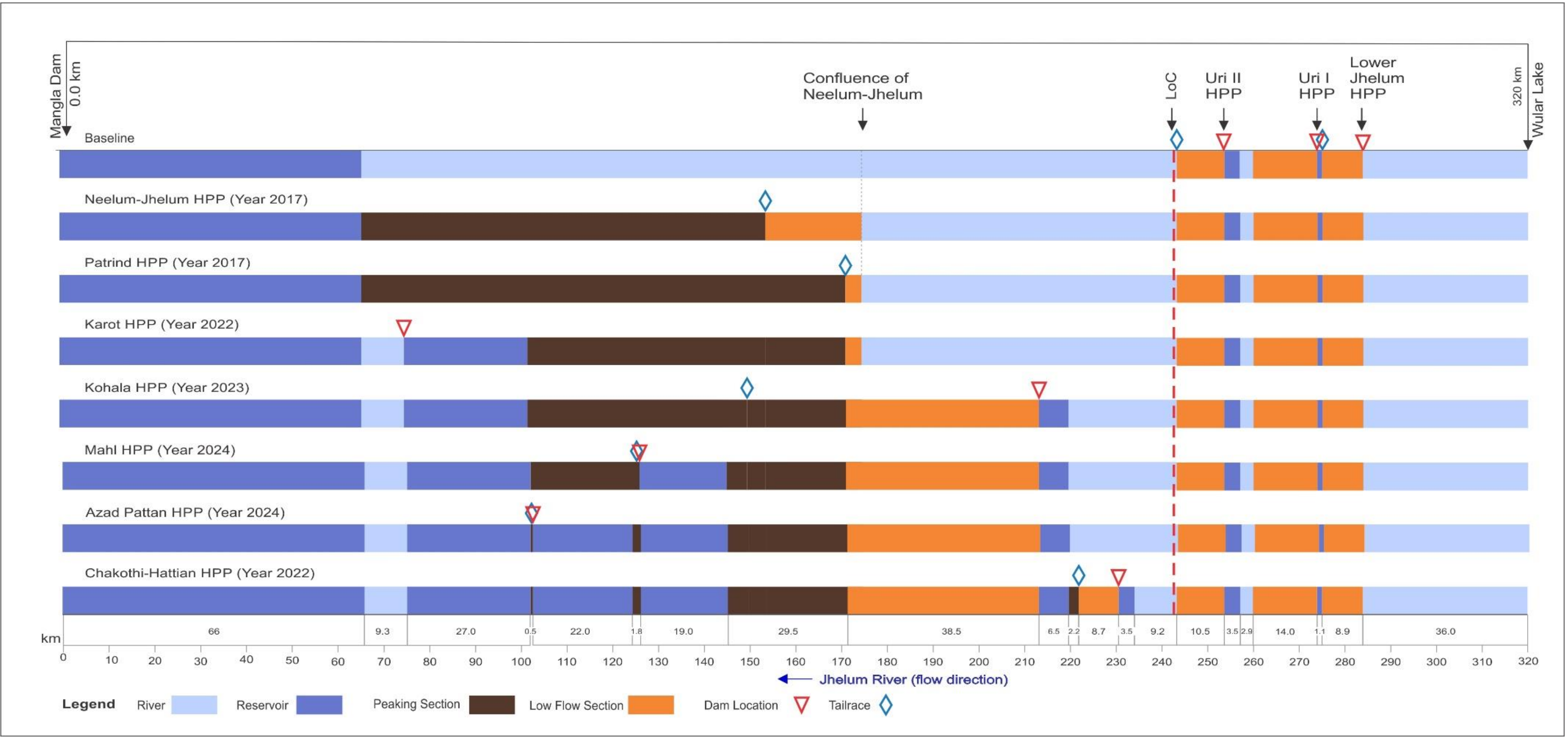
STEP 2 (SENSITIVITY)	
% estimate of national breeding population using the study area	>10
CEA *relative importance* category score	High
BirdLife Species Vulnerability Index (SVI) (wind farms and power lines)	10
IUCN regional conservation status	EN
CEA *vulnerability* category score	High
Sensitivity category score	**High**
STEP 3 (LIKELIHOOD OF EFFECT)	
Annual likelihood (%) of collision per individual from CRM estimates	17
LoE category score based on annual collision risk per individual	High
LoE category adjustment based on trends analysis and expert review	0
LoE category score adjusted	**High**
Final Risk Category Rating for Priority Bird VECs	**Major**
STEP 4 (THRESHOLDS)	
PBR level (annual fatality estimate)	0.3
Cumulative non–wind farm effects based on (i)–(iii) (annual fatality estimate)	>10
(i) Power line electrocution and/or collision (annual fatality estimate)	≥1 and <5
(ii) Illegal killing (annual fatality estimate)	≥5 but <10
(iii) Collection of live birds of prey (annual fatality estimate)	≥5 but <10
CRM estimate (annual fatality estimate)	2.5
Additional supporting information Unpublished PVA analysis from Israeli study of the South Israel–Jordan population predicts population declines over the period 2015–2055.[a]	
Primary Threshold Target	**Zero Fatality**

CIA EXAMPLE: HYDROPOWER PROJECTS IN PAKISTAN



Source: Hagler Bailly Pakistan. Jhelum-Poonch CIA, 2017.

CIA EXAMPLE: SPATIAL ANALYSIS IN PAKISTAN



Source: Hagler Bailly Pakistan. Jhelum-Poonch CIA, 2017.

OVERVIEW OF CIA METHODS

Method	Description	Advantages	Disadvantages	Cumulative Impacts
Expert Opinion	A means of both identifying and assessing indirect and cumulative impacts and impact interactions. Expert Panels can be formed to facilitate exchange of information of different aspects of the impacts of a project.	• Can consider such impacts as an integral part of the assessment.	• Some specialists or experts may be remote from the main project team.	✔
Consultations and Questionnaires	A means of gathering information about a wide range of actions, including those in the past, present and future which may influence the impacts of a project.	• Flexible • Considers potential impacts early on. • Can be focused to obtain specific information.	• Prone to errors of subjectivity • Questionnaire can be time consuming, and risk of poor response.	✔
Checklists	Provide a systematic way of ensuring that all likely events resulting from a project are considered. Information presented in a tabular format.	• Systematic method • Can develop 'standard' checklist for similar projects.	• Can allow oversight of important effects • Nature of cause-and-effect relationships not specified.	✔
Spatial Analysis	Uses Geographical Information Systems (GIS) and overlay maps to identify where the cumulative impacts of a number of different actions may occur, and impact interactions. Can also superimpose a project's effect on selected receptors or resources to establish areas where impacts would be most significant.	• GIS flexible & easy to up date. • Can consider multiple projects and past, present & future actions. • Allows clear visual presentation	• GIS can be expensive & time consuming. • Difficult to quantify impacts. • Problems in updating overlays.	✔

Method	Description	Advantages	Disadvantages	Cumulative Impacts
Network and Systems Analysis	Based on the concept that there are links and interaction pathways between individual elements of the environment, and that when one element is specifically affected this will also have an effect on those elements which interact with it.	• Mechanism of cause and effect made explicit. • Use of flow diagrams can assist with understanding of impacts.	• No spatial or temporal scale. • Diagrams can become too complex.	✔
Matrices	A more complex form of checklist. Can be used quantititively and can evaluate impacts to some degree. Can be extended to consider the cumulative impacts of multiple actions on a resource.	• Provides a good visual summary of impacts. • Can be adapted to identify and evaluate to some degree indirect & cumulative impacts and impact interactions. • Matrices can be weighted/ impacts ranked to assist in evaluation.	• Can be complex and cumbersome to use.	✔
Carrying Capacity Analysis	Based on the recognition that thresholds exist in the environment. Projects can be assessed in relation to the carrying capacity or threshold determined, together with additional activities.	• Addresses accumulation of impacts against thresholds. • Considers trends in the environment.	• Limited to data available. Not always able to establish the threshold or carrying capacity for a particular resource or receptor.	✔
Modelling	An analytical tool which enables the quantification of cause-and-effect relationships by simulating environmental conditions. This can range from air quality or noise modelling, to use of a model representing a complex natural system.	• Quantifies cumulative effects • Geographical and time-frame boundaries are usually explicit • Addresses specific cause-and-effect relationships	• Often requires large investment of time and resources • Can be difficult to adapt some models to a particular project. • Depends on baseline data available.	✔

Source: European Commission 1999.

CIA EXAMPLE: HYDROPOWER PROJECT IN INDIA

They used the Argonne Multiple Matrix (AMM) Method.

Scenarios assessed:

1. **Cumulative impact significance of all projects (current and future).**

2. **Only commissioned projects.**

3. **Combined impacts of all commissioned projects and those under construction.**

4. **Only the proposed projects.**

5. **Alternative scenarios by exclusion approach (sequentially exclude projects).**

Source: Rajvanshi, Asha; Roshni Arora; Vinod B. Mathur; K. Sivakumar; S. Sathyakumar; G.S. Rawat; J.A. Johnson; K. Ramesh; NandKishor Dimri and Ajay Maletha (2012) Assessment of Cumulative Impacts of Hydroelectric Projects on Aquatic and Terrestrial Biodiversity in Alaknanda and Bhagirathi Basins, Uttarakhand. Wildlife Institute of India, Technical Report. Pp 203 plus Appendices

EXAMPLE: HYDROPOWER PROJECT IN INDIA
SCENARIO 1- CUMULATIVE IMPACTS OF ALL PROJECTS

Table 6.2 Interaction matrix for Scenario Ia.

Name of sub-basin	Impact potential based on project profile*	Aquatic biodiversity value	Impacts significance
Bhagirathi I	M	M	M
Bhagirathi II	M	H	M
Asiganga	M	H	M
Bhagirathi III	VH	H	VH
Bhagirathi IV	H	VH	VH
Bhilangana	M	H	M
Balganga	M	H	M
Alaknanda I	M	VH	H
Mandakini	M	H	M
Alaknanda II	M	H	M
Pindar	M	H	M
Nandakini	M	H	M
Birahi ganga	H	H	H
Rishi ganga	M	M	M
Dhauli ganga	H	M	M
Bhyundar ganga	L	L	L
Alaknanda III	M	M	M
Ganga Basin	H	VH	VH

EXAMPLE: HYDROPOWER PROJECT IN INDIA RESULTS

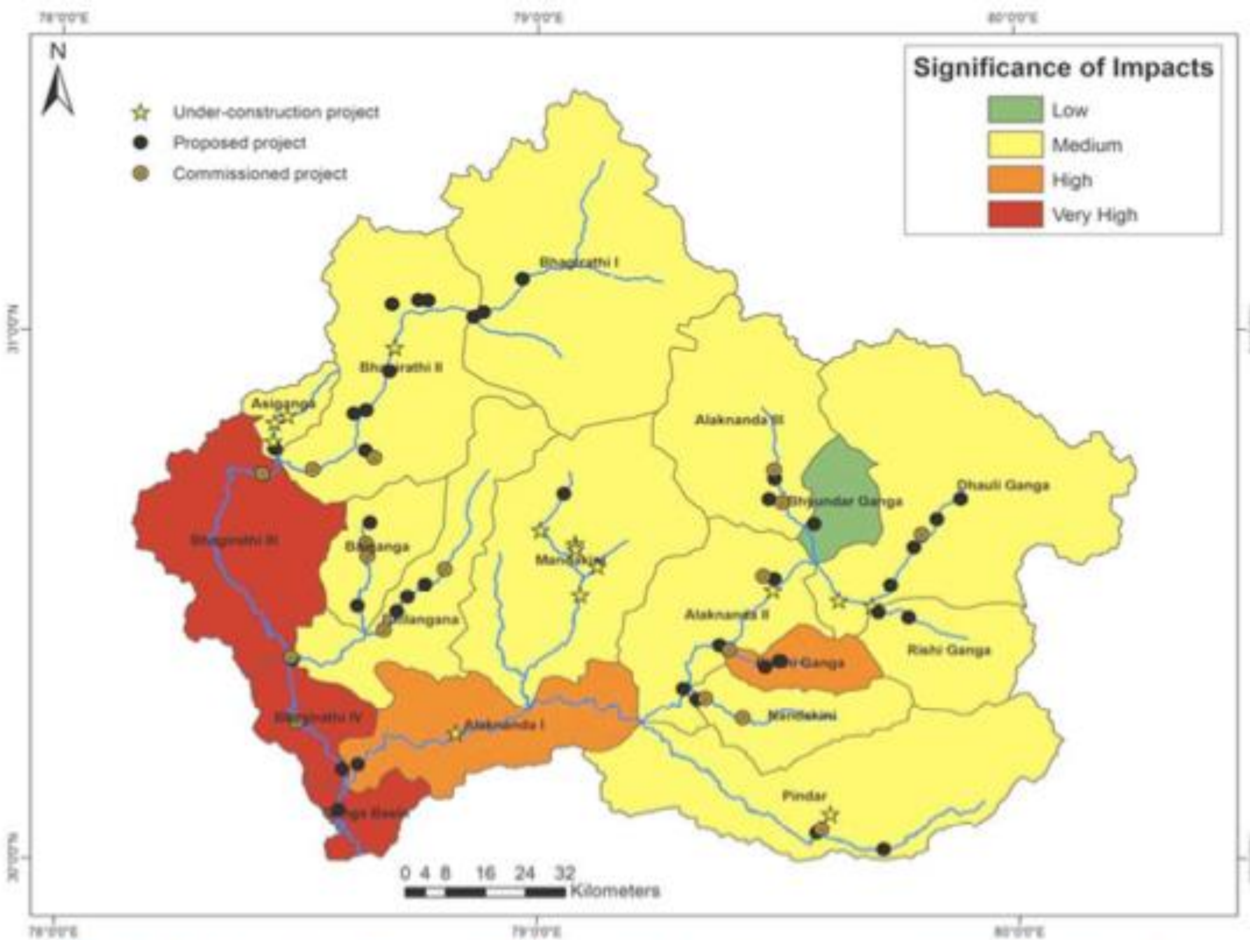


Fig. 6.1 Predicted significance of impacts of all projects on aquatic biodiversity values.

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CIA METHODS: EFLOWS MODELS

For Hydropower and aquatic impacts, Environmental Flows (EFlows) Models can be used

Holistic Models with scenarios are especially suitable

DRIFT: DOWNSTREAM RESPONSE TO IMPOSED FLOW TRANSFORMATIONS (DRIFT)

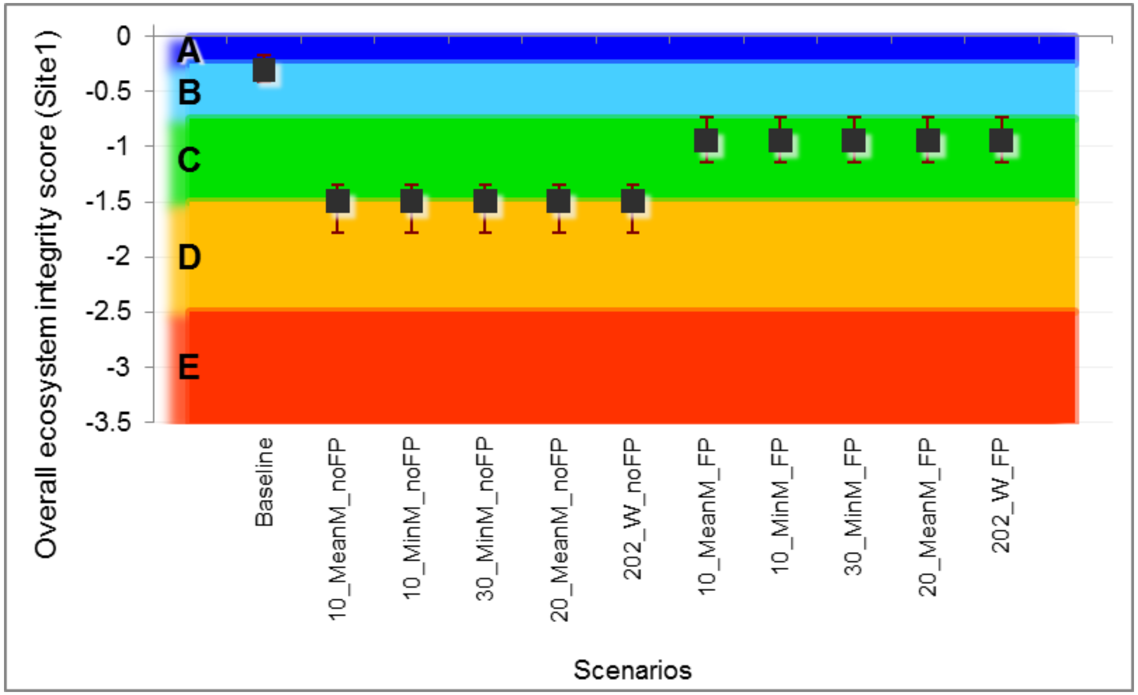
DRIFT uses the present-day flow regime of the river as a starting point, then holistically describes the biophysical and social consequences of several possible future flow regimes, or flow scenarios, each of them comprising a different combination of flow reductions.

Can also be used in CIA to assess scenarios with different combinations of development projects and other stressors on the VECs.

CIA EXAMPLE: DRIFT ECOLOGICAL STATUS

DRIFT results can be focused on particular VECs (such as fish, sediments)

DRIFT can also evaluate overall Ecological Status and compare scenarios



Source: SAN Engineering 2017, for Upper Trishuli-1

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BREAKOUT SESSION #2

Choose two of the VECs you identified during Session #1

Discuss and fill in table for:

- What metric(s) would be assessed for each VEC?
- What data are available to assess this metric?
- How to fill in data gaps?
- Which method(s) would be suitable for impact assessment?

VEC	Metric	Data Source	Data Gap	Method

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