e-PROMETHEE Days 2020

Performance of endogenous adaptation measures to the flooding risk in the context of climate change in the urban municipality of Gueckédou in Guinea

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Flooding in the context of climate change

In 2007, the IPCC referred in these projections to 2020:

- 75 to 250 million people would be exposed to climate change;

- Heavy rainfall events are expected to increase significantly in many regions;

- the associated increased risk of flooding would have environmental, social and economic impacts.

By 2018, the IPCC found that these projections had even been exceeded. With a global warming of 1.5° C, the climate-related risks for floods, livelihoods and human security will increase further.

They have become one of the major climate issues in developing countries, in urban areas, despite current knowledge there is no adequate response.

The causes of floods: example of Guinea

Exponential population growth

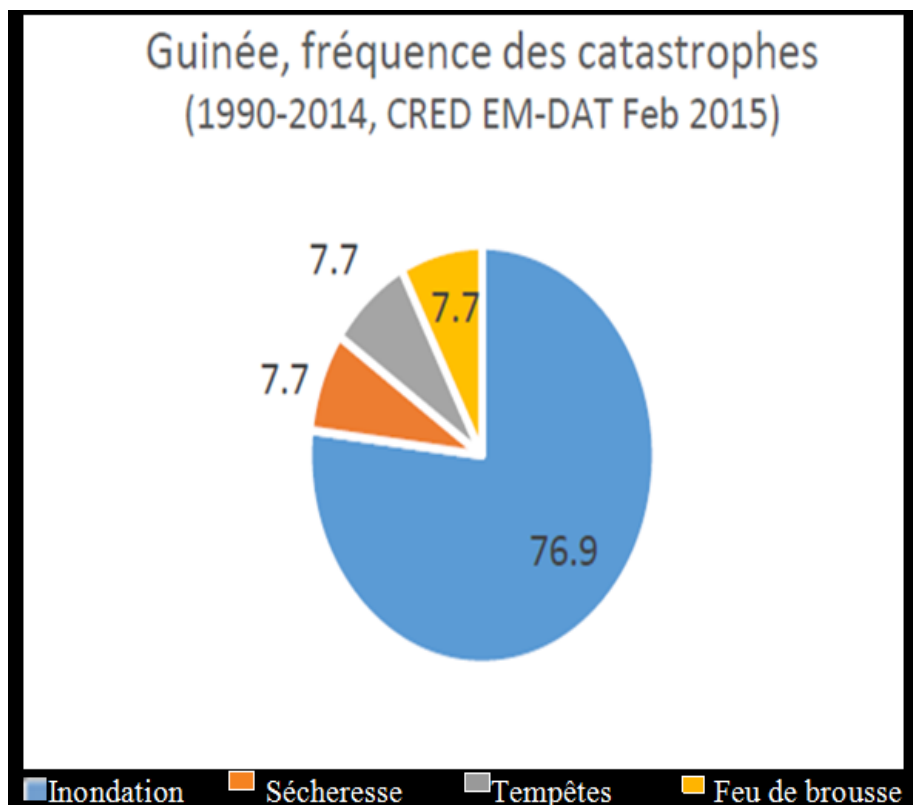Poverty

Uncontrolled urbanization

Degradation of natural ecosystems

Insufficient policies urban development and global warming

(Gemenne et *al*., 2014)   3

The case of Guinea

- PANA-Guinea (2007): flooding is one of the climatic risks in Guinea

SNU (2016): Disaster frequency in Guinea

- By 2019 (ENA-guinea, 2019)

  - 200 families affected in Gueckédou

In Guinea, insufficient State control over urbanization and the state of poverty of the population lead to the illegal occupation of areas at risk of flooding.

The case of the urban munipality of Gueckédou

- Since the 1970, the urban commune of Gueckédou has been exposed to flood phenomena.

  People's desire for land ownership, and the desire to be close to all basic social services, leads them to greater exposure.

- The environmental, socio-cultural and economic impacts of flooding in the CUG are :

- loss of life,

- farm losses,

- service interruptions,

- public health issues,

- periodic involuntary population displacements.

Relief in the form of a hollow plate

Photo ena-Guinée, juillet 2019

Planning theories and key concepts

❑ Planing theories

▪ *Strategic planing*

Context multi-actor

Multiples issues

Compréhensive understanding of environmental, social and economic implications

Arnstein (1969); Mintzberg (1994); Brown et Thérivel (2000); Risse (2004); Mintzberg *et al.,* (2009); Griggs et al., (2013); Lallemand-Stempak; (2015) Desreumaux (2015); Waaub (2017); Yonkeu et Bouchard (2019) et Lanmafankpotin (2019)

▪ *Participatory planing*

Role of the expert to the moderator in the process;

Integrates atakeholders considerations at all levels of the process;

Flexible and adaptive

❑ Sustainable development

- ▪ Environmental
- ▪ Socio-cultural and
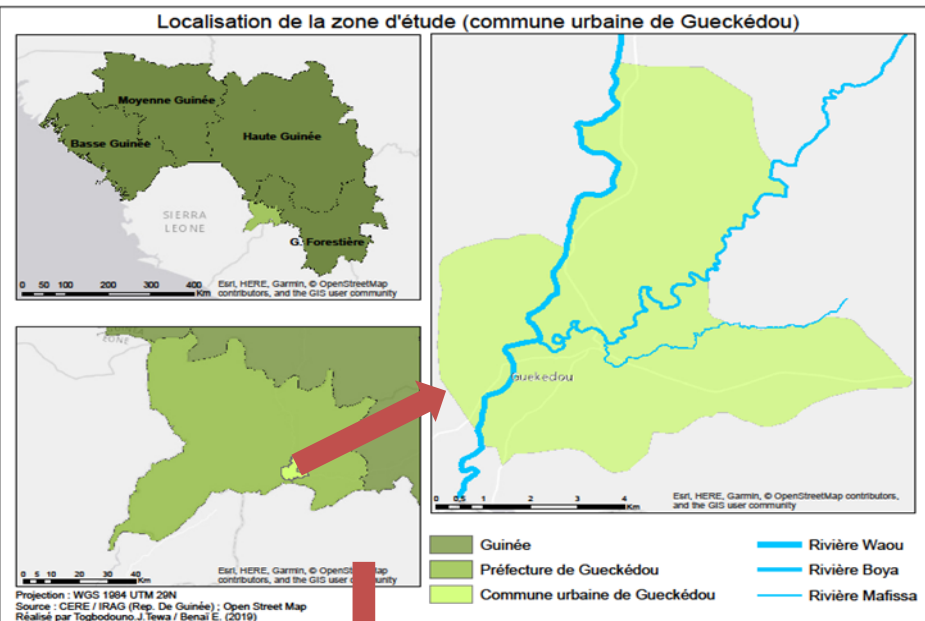- ▪ économic
- ▪ ODD horizon of 2030

❑ Concepts

- ▪ Performance
- ▪ Endogenous measures
- ▪ Adaptation, climate change
- ▪ Flood risk
- ▪ Évaluation

CMED (1987); ACÉE (2003); Kourouma (2005); Waaub (2012); Mala *et al.* (2019) ; Gleyze (2002); Ledoux (2006); GIEC (2014)

The urban municipality of Gueckédou (CUG)

Localisation de la zone d'étude (commune urbaine de Gueckédou)

Projection : WGS 1984 UTM 29N
Source : CERE / IRAG (Rep. De Guinée) ; Open Street Map
Réalisé par Togbodouno.J.Tewa / Benaï E. (2019)

Légende:
- Guinée
- Préfecture de Gueckédou
- Commune urbaine de Gueckédou
- Rivière Waou
- Rivière Boya
- Rivière Mafissa

Population CUG: 71 298 inhabitants

The Makona river basin 8 384 km2

- The Makona (262 km)

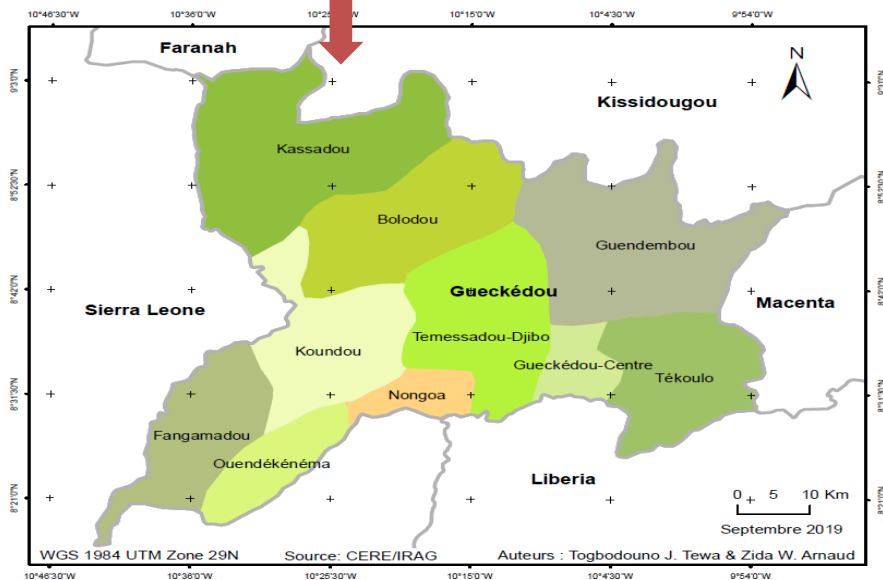- Tributaries: La Boya (45 km),

  la Waou (133 Km)

Climat équatorial guinean.

Deux seasons

5 months dry and 7 months wet

Annual rainfall, plus 3000 mm with an average of 2500 mm. Plus 500 mm of rain in August.
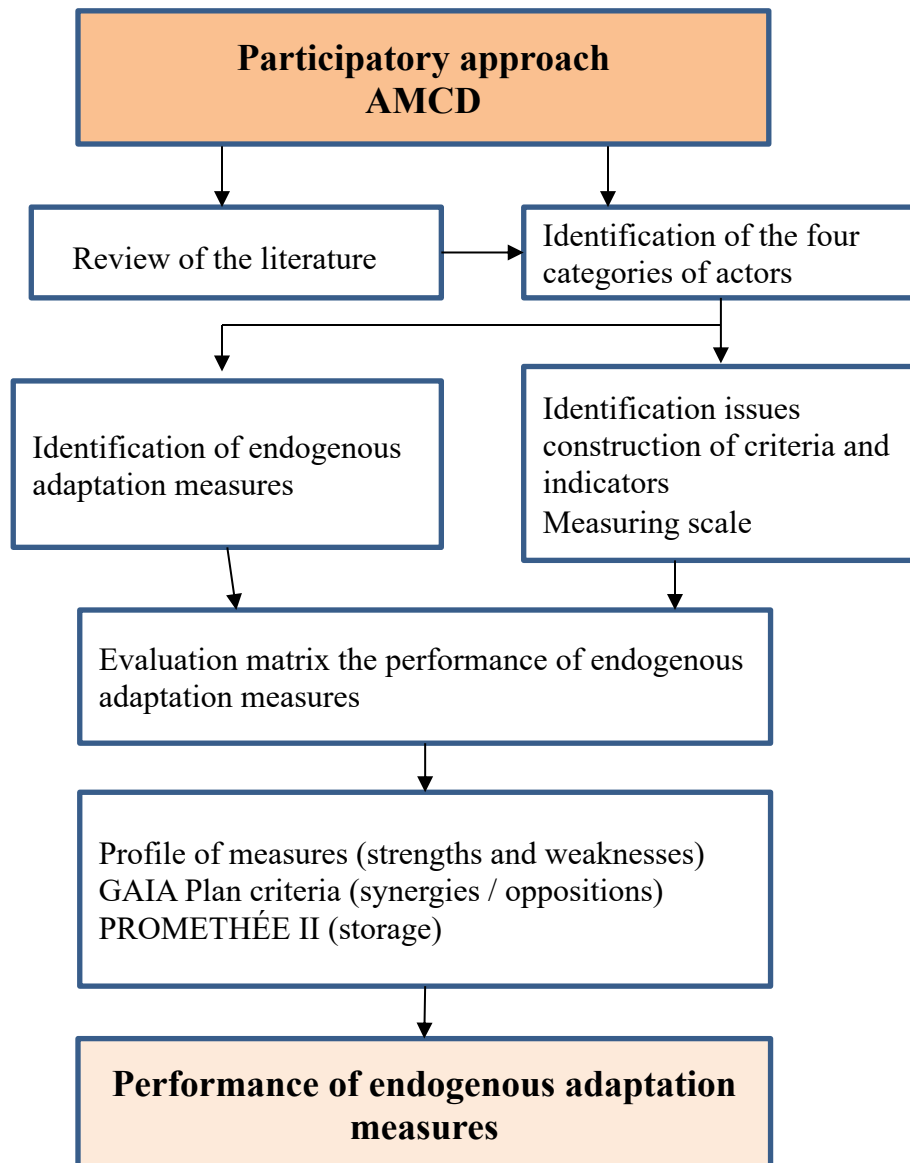
(IRAG (2011); DPEF (2012); DNM (2013); INS (2017); INS (2019))

Objectifs de l'étude

1. Proposer un modèle de gestion durable du risque d'inondation dans la commune urbaine de Gueckédou.

2. Évaluer la vulnérabilité des communautés et des ressources face au risque d'inondation dans la commune urbaine de Gueckédou.

3. **Évaluer la performance des mesures endogènes d'adaptation aux inondations des communautés dans la commune urbaine de Gueckédou en Guinée.**

Evaluation of the performance of endogenous measures

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┌─────────────────────────────┐
│   Participatory approach     │
│          AMCD                │
└─────────────────────────────┘
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┌──────────────────────┐     ┌──────────────────────┐
│ Review of the        │───▶ │ Identification of the│
│ literature           │     │ four categories of   │
│                      │     │ actors               │
└──────────────────────┘     └──────────────────────┘
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┌──────────────────────┐     ┌──────────────────────┐
│ Identification of    │     │ Identification issues│
│ endogenous           │     │ construction of      │
│ adaptation measures  │     │ criteria and         │
│                      │     │ indicators           │
│                      │     │ Measuring scale      │
└──────────────────────┘     └──────────────────────┘
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┌──────────────────────────────────────────┐
│ Evaluation matrix the performance of      │
│ endogenous adaptation measures            │
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┌──────────────────────────────────────────┐
│ Profile of measures (strengths and       │
│ weaknesses)                               │
│ GAIA Plan criteria (synergies /          │
│ oppositions)                              │
│ PROMETHÉE II (storage)                    │
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┌──────────────────────────────────────────┐
│   Performance of endogenous adaptation    │
│              measures                     │
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AMCD
Frini *et al*., 2019; Samoura, 2019; Mareschal, 2018; Waaub, 2017; Waaub et Belanger, 2015

Categorization of actors according to the typology of Prades and al., (1998)

Selection of participants

- structure designation
- Choice of neighbourhoods
- Flood report
- Technical Services

According to Diallo *and al*, 2017

The software Visual PROMETHEE

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Performance of endogenous adaptation measures

❑ Identification of actors

Actors Gouvernment (administration Public)	Concerns regarding endogenous flood adaptation measures
Direction préfectorale de l'environnement, des eaux et forêts	Pollution du cadre de vie, dégradation de la végétation Perte d'espèces animales et végétales
Direction prefectural of agriculture	**Destruction of crops lowlands and plains**
Direction Préfectorale de la Météo	Évaluation des pertes de superficies agricoles et de leur réaffectation
Direction Préfectorale de la santé	Prévisions des inondations
Mairie, et autres élus locaux (chefs de quartier, chefs de districts)	Prévention et gestion des maladies d'origine hydrique Inventaire des dommages lors des inondations
Direction Préfectorale de l'Urbanisme et Habitat	Implication dans la coordination des actions d'intervention (premiers secours) Arbitrage dans l'affectation des terres Réduction des déplacements involontaires de populations, consolidation du bâti
Direction Préfectorale de l'éducation	Perturbation scolaire, travers sociaux
Direction Préfectorale des micro réalisations	Qualité des infrastructures de franchissements et des pistes rurales
Direction nationale de l'hydraulique	Intervention pour assurer le fonctionnement des infrastructures (désenclavement) Système de prévision centralisé des crues et étiages Fonctionnement par intermittence des stations limnométriques ainsi que des plateformes de collecte de données (PCD)

Prades *et al*. (1998)

Performance of endogenous adaptation measures

❑ Identification of actors

Categories of actors	Actors	Concerns regarding endogenous flood adaptation measures
Economic	Représentant filière riz Représentant chambre de commerce Représentant groupement agricole Benda kissia Représentant groupement agricole Germaine	Insuffisance des moyens financiers octroyés pour l'aménagement des sites de relocalisation Accroissement de la participation des populations à la prévention et à la gestion des inondations **Reduction of property losses**
Civil society	ONGs APROSA Croix-rouge Plan-Guinée Chefs coutumiers Organisations paysannes (OP) Représentant AACCG	**Respect for tradition (no construction on river banks)** Perte d'éléments culturels
Expert	**Consultants: Institut de Recherche Agronomique** Consultant hydro-technicien Consultant environnementaliste	Production des cartes des zones inondables **Increased agricultural production** Biodiversité

Prades *et al*. (1998)

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Performance of endogenous adaptation measures

❑ Issues, Criteria , indicators and measuring scale

Issues	Criteria	Indicators	Measuring scale
Environmental dimension			
Avoiding losses in agricultural productivity	**Strengthening the agricultural yield (ENV1)**	**Level of strengthening of agricultural yield**	**Max : null, low, medium, strong; numerical scal corresponding : 0, 1, 2, 3**
Assurer la préservation des espaces forestiers	Niveau de contribution à la préservation des espaces forestiers en zones dégradées (**ENV2**)	Niveau de contribution	Max : nul, faible, moyen, fort; échelle numérique correspondante : 0, 1, 2, 3
Flexibilité de la mesure en fonction du risque d'inondation	Niveau d'adéquation de la mesure en fonction de la variabilité de la durée des saisons (**ENV3**)	Niveau d'adéquation	Max : nul, faible, moyen, fort; échelle numérique correspondante : 0, 1, 2, 3

Performance of endogenous adaptation measures

❑ Issues, Criteria , indicators and measuring scale

Issues	Criteria	Indicators	Measuring scale
Sociocultural dimension			
Éviter les déplacements de populations	**Displaced population by the implementation of the measure (SOC1)**	**Level large-scale des displacements**	**Min : null, low, medium, strong; numerical scal corresponding : 0, 1, 2, 3**
Garantir la sécurité **des** populations	Risque d'accidents liés à la mise en œuvre de la mesure (**SOC2**)	Niveau de risque	Min : nul, faible, moyen, fort; échelle numérique correspondante : 0, 1, 2, 3
Assurer la protection des sites culturels	Niveau de perturbation des sites sacrés (**SOC3**)	Niveau de perturbation	Min : nul, faible, moyen, fort; échelle numérique correspondante : 0, 1, 2, 3
Assurer la conservation des produits agricoles pour l'autonomie alimentaire et le commerce	Niveau de perte post-récolte lié à l'application de la mesure (**SOC4**)	Niveau de perte	Min : nul, faible, moyen, fort; échelle numérique correspondante : 0, 1, 2, 3
Favoriser les changements de comportement	Niveau de facilité d'adoption de la mesure (**SOC5**)	Niveau de facilité	Max : nul, faible, moyen, fort; échelle numérique correspondante : 0, 1, 2, 3

Relocalisation planned has been identified as a form of adaptation to climate change.

(CCNUCC, 2010)

Performance of endogenous adaptation measures

❑ Issues, Criteria , indicators and measuring scale

Issues	Criteria	Indicators	Measuring scale
Economic dimension			
Minimise costs investment public or private for the implementation of adaptation measures	**Manitude of the costs the implementation of the measure per hectare (ÉCO1)**	**Level of magnitude of costs**	**Min : null, low, medium, strong; numerical scal corresponding : 0, 1, 2, 3**
Préserver les sources de revenus agricoles	Niveau de contribution à la production agricole (**ÉCO2**)	Niveau de contribution	Max : nul, faible, moyen, fort; échelle numérique correspondante : 0, 1, 2, 3

The criteria and indicators have not been validated by the actors (contraint relatted to Ebola), the evaluation matrix was carried out according to experts.

❑ Endogenous flood adaptation measures by implementation categories

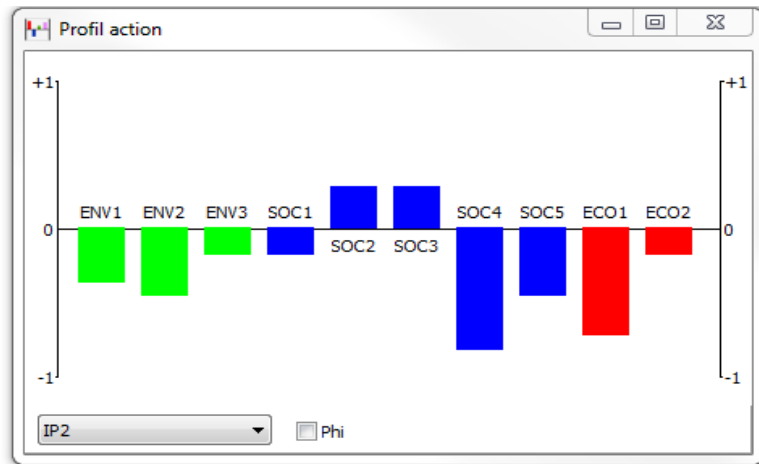| Categories of measures	Measures
Intervention measures physic: IP	IP1 Élévation des contres soubassements de 1m de hauteur ou plus devant les maisons **IP2 Construction of protective dikes in front of houses** IP3 Percement de trous à l'arrière des bâtiments pour le passage de l'eau avant les inondations
Measures concerning agricultural knowledge: SA	**SA1 Use of an agricultural calendar integrating the flood constraint** SA2 Utilisation des variétés hâtives de 3 mois SA3 Utilisation d'une technique de repiquage du riz adaptée dans les bas-fonds SA4 Utilisation de résidus de récolte et de sous-produits pour la fertilisation des sols afin d'éviter des jachères longues (intensification) SA5 Utilisation des techniques traditionnelles de conservation des produits agricoles (mise en hauteur)
Early warning measures base on endogenous knowledge: AP	AP1 Utilisation d'un ou plusieurs des systèmes d'alertes précoces suivants : • **Observation by local communities of the frog « wentada » movement from the water to the banks as a warning sign of flooding** • Observation de la hauteur des nids des oiseaux semi-aquatiques au-dessus des cours d'eau comme signe annonciateur d'inondation • Utilisation des connaissances liées au fait que quand la saison pluvieuse est plus longue, après la saison sèche, l'année suivante, la probabilité de la survenue d'une inondation est forte
Intervention measures social and territorial: IS	IS1 Sensibilisation, information et accompagnement des sinistrés vers d'autres zones IS2 **Conservation totemism by the « totem » of biodiversity** IS3 Mise en défens de certaines forêts et de certains cours d'eau

Performance of endogenous adaptation measures

❑ Matrix for assessing the performance of endogenous adaptation

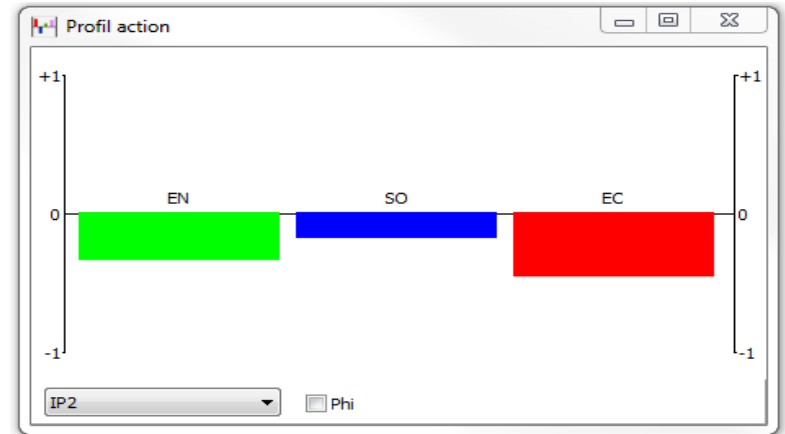| Scénario1	ENV1	ENV2	ENV3	SOC1	SOC2	SOC3	SOC4	SOC5	ECO1	ECO2
Unité	unit	unit	unit	unit	unit	unit	unit	unit	unit	unit
Cluster/Groupe	🟩	🟩	🟩	🟦	🟦	🟦	🟦	🟦	🟥	🟥
Préférences										
Min/Max	max	max	max	min	min	min	min	max	min	max
Poids	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Fn. de préférence	Usuel	Usuel	Usuel	Usuel	Usuel	Usuel	Usuel	Usuel	Usuel	Usuel
Seuils	absolu	absolu	absolu	absolu	absolu	absolu	absolu	absolu	absolu	absolu
- Q: Indifférence	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
- P: Préférence	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
- S: Gaussien	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Statistiques										
Minimum	0	0	0	0	0	0	0	1	0	0
Maximum	3	3	3	3	2	2	2	3	3	3
Moyenne	1	1	1	1	0	0	1	2	1	1
Ecart-type	1	1	1	1	1	1	1	1	1	1
Evaluations										
IP1 🟣	0	0	1	1	0	0	1	2	3	0
IP2 🟣	0	0	1	1	0	0	2	2	3	1
IP3 🟣	0	0	2	2	2	0	0	2	1	0
SA1 🟢	3	2	3	0	0	2	2	3	1	3
SA2 🟢	2	0	3	0	0	0	2	3	3	2
SA3 🟢	2	0	0	0	0	0	0	3	0	0
SA4 🟢	3	1	0	1	0	1	0	2	0	3
SA5 🟢	0	0	0	0	1	0	1	3	2	3
AP1 🔵	0	0	2	2	0	0	0	3	0	2
IS1 🟡	0	2	2	3	1	1	0	2	3	2
IS2 🟡	0	3	0	0	0	0	0	3	0	1
IS3 🟡	0	3	2	1	0	0	0	1	0	0

Measuring scale: strong =3, medium=2, low=1 et nul=0.

Performance of endogenous adaptation measures

❑ Profile of the measure IP2: Construction of protective dikes in front of the houses

Profile of the measure IP2 for all criteria.

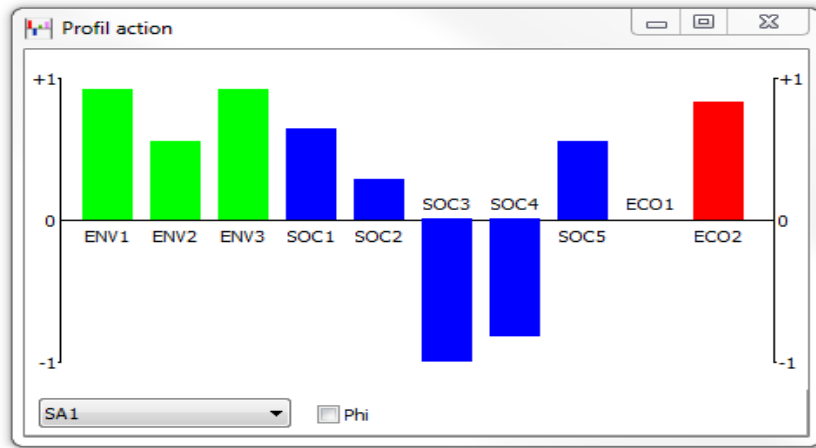Profile of the criteria group of the measure IP2.

This measure is not generally effective for none of the three groups of criteria

The level of assurance of dikes is explicitly lower than other measures and they can give way before the water level reaches the flood level.

(Royet *and al*., 2016)

Performance of endogenous adaptation measures

❑ Profile of the measure SA1:use of an agricultural calendar integrating the flood constraint

Profile of the measure SA1 for all criteria

Profile by group of criteria for the measure SA1

This measure is effective for the groups of criteria environmental and economic, and has a slight weaknesfor the socio-cultural criteria group.

The Convention on Biological Diversity on traditional knowledge associated with ressources in its article 8, p.7.

(Nations -Unies, 1992)

Performance of endogenous adaptation measures

❑ Profile of the measure AP1: Early warning measures base on endogenous knowledge

Profile of the measure AP1

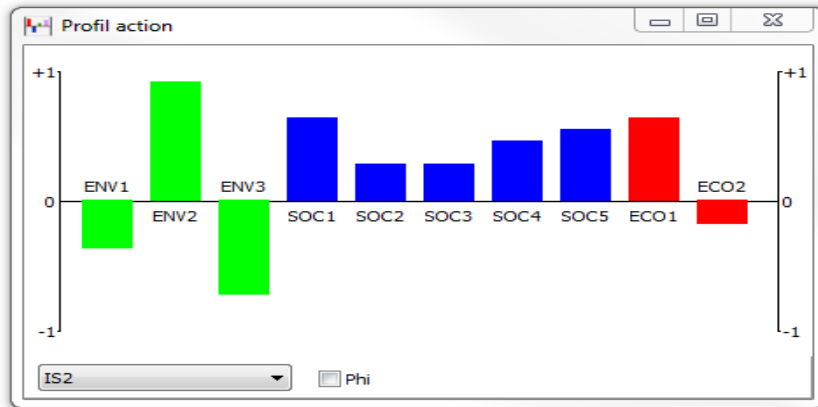Profile per group the criteria of the measure AP1

It performs well on the economic and a little less sur with that of criteria sociocultural and isn't on the group the criteria environmental.

These types of measures still require be validated or have scientific recognition.

(Mala *et al*., 2019)

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Performance of endogenous adaptation measures

❑ Profile of the measure IS2: conservation by totemism of fauna and flore
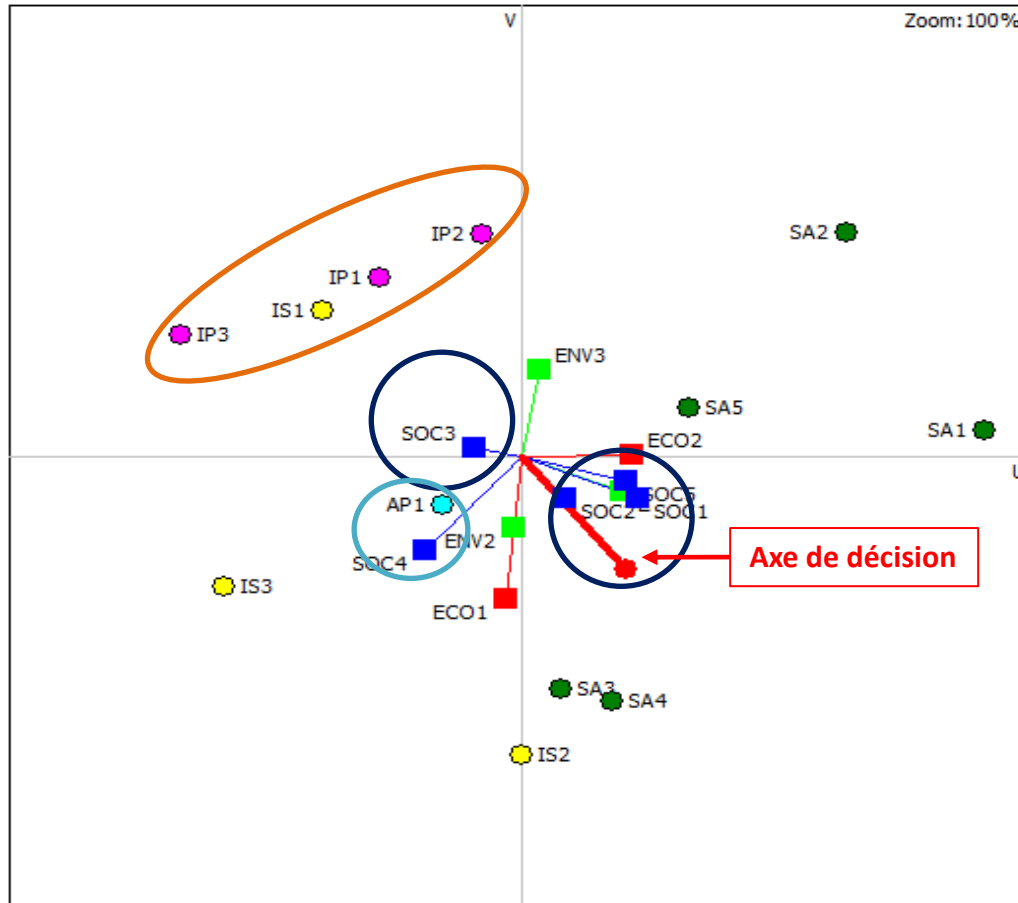

Profile of the measure IS2

Profile per group the criteria of the measure IS2

It performs well on the rwo groups of criteria est performante sur les deux groupes de critères sociocultural and economis and shows a slight weakness on the environmental criteria group.

They remain relevant for decision-making at the locally and can support scientific knoledge.

(Louafi, 2019)
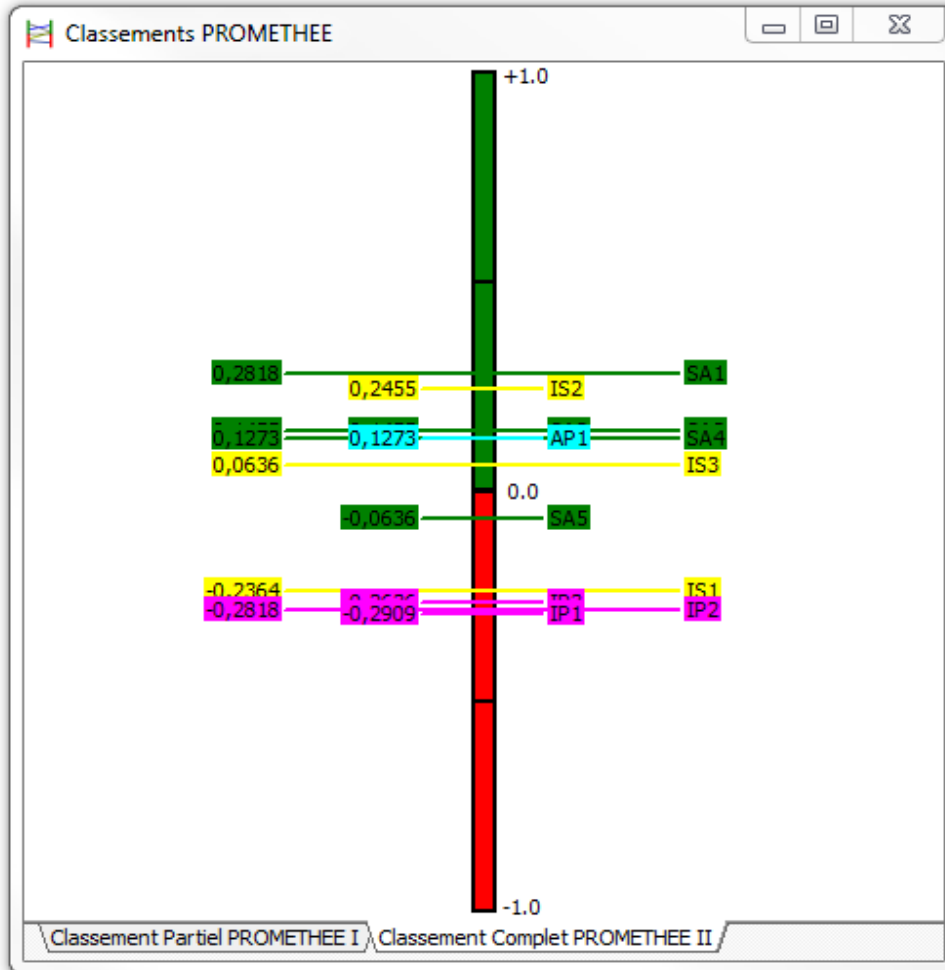
Performance of endogenous adaptation measures

❑ Plan GAIA criteria

The criteria SOC1, SOC2, ENV1,

And SOC5 are in synergies,

And are also in opposition with the

criteria SOC3. This means that

when a measure is performing on

the criteria it will not be on SOC3.

Performance of endogenous adaptation measures

❏ PROMÉTHÉE II: storage measures

Order of performance

SA1: Use of an agricultural calendar integrating the flood constraint

IS2: Conservation by totemism of fauna and flore

SA2: Use of 3-month early varieties

SA3: Use of adapted rice transplant technique in the shallows

SA4: Use of crop residues and by-products for soil fertilization to avoid long fallow (intensification)

AP1:Use of one or more early warning systems

IS3: Protection of certain forests and waterways

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Conclusion

The following measures are quitte complementary, such as:

- SA3 : Use of adapted rice transplant technique in the shallows ,

- SA4 : Use of crop residues and by-products for soil fertilization to avoid long fallow (intensification)

- IS2 : Conservation by totemism of fauna and flore

  They are the first coalition group. Their combination would increase agricultural production.

Measures:

- SA1: Use of an agricultural calendar integrating the flood constraint

- SA2 : Use of 3-month early varieties), and

- SA5: Use of traditional techniques from conservation of agricultural products (put in height).

   Are the second coalition group.

Integration of endogenous measures into community policies of adaptive capacity building promoting sustainable development.

Contribution of the study

- The study shows the need for the participation of several actors, but also, taking their concerns into account in the process.

- L'AMCD participatory such assessment methodology of the performance the endogenous measures has been to highlight their strengths and weaknesses and led to the selection of the measures endogenous the combination of which would make it possible build scenarios performing adaptation;

- To highlight new know-how for urban local communities for the strengthening urban and agricultural resilience.

Recommandations

The study recommends that:

- Make use of knowledge – based endogenous measures and knowledge to build capacity and   intensity of the risk exposure;

- Integrate the full participation of women in decision-making process (management board) to make better decisions, for capacity building in the face of floods;

- Assess the possibility of relocation the communities residing in flood-prône areas, with a plan to redevelop these areas to increase resilience.

Thank you very much your attention!!