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An Integrated Approach for Provision, Mapping and Evaluation of Ecosystem Services and Implementation of the Environment and Planning Act (EPA) in Ede Municipality

MSC THESIS, DOUBLE DEGREE ORGANIC AGRICULTURE-AGROECOLOGY

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Abstract:

The Dutch Environmental and Planning Act (EPA) is a new legislations which offers an instrument for municipalities to move towards a more integrative approach in land use and spatial planning policies. The focus of this legislation is to preserve and improve good quality of physical living environment and balanced allocation between functions to locations. Both of these topics are related to ecosystem services, however incorporating this concept into policies remains a gap. This study was carried out to contribute to the goals of the municipality of Ede in the Netherlands for a holistic approach in spatial planning and land use policies and to uplift ecosystem services provision. There are conflicts and synergies between use and preserving the ecosystem in addition to competition for land between different types of land use while the interests of different groups of the society can also be colliding. Ecosystem services can help to understand these conflicts. To embrace ecosystem services in policies, finding the right indicators and a suitable mapping and evaluation approach is crucial. So, literature review and semi-structured interviews with local stakeholders were conducted and the data were used to design frameworks to help policy makers in writing the new policies. The final frameworks suggest use of Benefit Relevant Indicators to bring the concept of ecosystem services into policymaking. A holistic view about the effect of policies on quality of the environment for different groups of the society is recognized in these frameworks. Moreover, connecting policies to management of the physical environment and societal benefits is incorporated into these frameworks.

Keywords: Ecosystem services, Ecosystem approached policies, Benefit relevant indicators, Dutch Environmental and Planning Act (de Omgevingswet 2021).

1. Introduction:

Ecosystems contribute directly or indirectly to the wellbeing of the society in form of Ecosystem services (ES). Many types of ecosystem services can be considered as public goods, for example water regulation and climate adaptation. Other forms are related to people’s basic needs such as provision of food and raw material. The third group of ES are related to mental and physical health of people and the quality of life. Examples include aesthetic of the landscape and opportunities for recreation activities (Englund et la., 2017; Gutman, 2007; TEEB, 2010). As a result, in both rural and urban areas, ES have a close relationship with the viability of a place and the wellbeing of the residents. Furthermore, ES can be divided into intermediate and final services. For example, while producing fruit is a final service, pollination is an intermediate service. Pollination has direct financial benefit for fruit producers. However, pollination does not benefit directly the consumers but in form of fruit production. So, intermediate services do not benefit directly the final users but are necessary for production of the final service

(Antognelli et al., 2018). It is also important to distinguish between ecosystem services and ecosystem functions. As the latter describes the capacity of a specific ecosystem to provide goods and services based on its features and the interactions of different features within the ecosystem (TEEB, 2010). While in some studies ecosystem functions are considered the same as the ecosystems services, the wide range of functions and services have different impacts on different groups of the society. For instance, while many Ede residents enjoy recreational activities in Hoge Veluwe national park, increasing housing projects at the borders of the park has had negative impact on water availability in nature areas which in turn can affect recreational capacity of the park. The same applies for defining ecosystem functions as indicators because a function can have different impact or benefit for different stakeholders and mapping the function directly does not necessarily portrays the final benefits received by the society (Olander et al., 2018; Ortega-Cisneros et al., 2018). For example, prioritizing wetland restoration by distinguishing which functions of each wetland are more valued or demanded by humans, instead of assuming all wetlands have the same services just by being a wetland. This helped decision makers to adapt policies for wetlands that were important for flood prevention than wetlands that provided habitat for important fish species (Olander et al., 2017). The same approach is used in present study and ecosystem services are distinguished from ecosystem functions.

To preserve the ecosystems and maintain the provision of ES, environmental and land use policies play a crucial role. In case of the Netherlands, protecting the natural environment has been recognized in Dutch legislation in article 21 of the Dutch constitution (de Graaf at al., 2018). Urban sprawl and modern agriculture has led to fragmentation in the landscape and as a result the concept of efficiency in land use was introduced to Dutch policies. Therefore, a land allocation plan was designed for each region and the construction permits were issued based on this plan. Traditionally, Dutch spatial planning policies are focused on segregating different land uses in rural areas. This segregation has led to conflicts between different land uses considering the negative environmental consequences of intensive livestock production as the main agricultural activity in the region (van der Valk, 2002).

Policy instruments are means that governments use to change the behavior of groups and individuals within different business sectors or parts of the society. There are different types of policy instruments, however, the Netherlands is a successful example of using Joint Environmental Policy Making (JEP). The Dutch policy style is mainly based on reaching a consensus. This mindset facilitates negotiating, designing and executing the agreements by public and private actors (Connelly and Smith, 2003). Aligned with JEP approach, the Environmental and Planning Act (EPA) or De Omgevingswet 2021 is a new piece of law that will bring remarkable changes to the

Dutch environmental law. This legislation will be a substitute for the current fifteen legislations of the Dutch environmental policies. The main purpose of merging several policies into EPA is to achieve a more active approach in management of urban and rural areas (own translation of EPA). Based on EPA, national, provincial and municipal governments are required to write a specific plan for the physical living environment, i.e. de fysieke leefomgeving, of the area under their authority (de Graaf et al., 2018; aandeslagmetdeomgevingswet.nl).

Integrating an ES framework into planning and decision-making is more and more perceived as a tool in order to establish an ecosystem approach. An ecosystem approach realizes the shortfall of knowledge on ES and the complexity of ecosystems. The goal of an ecosystem approach is to maintain the integrity of ecosystems via policies and move towards sustainable use and distribution of resources. In addition, mapping and evaluation of ES are required for an ecosystem approach as mapping can help to understand the conflicting interests of different stakeholders while ES evaluation can shed light on the impact of ES degradation on socio-economic aspects. Foremost, municipality territories are often comprised of compound landscape so policy makers need indicators that can deal with this complexity (Antognelli et al., 2018; de Graaf et al 2018; Vorstius and Spray, 2015).

Ecosystem services are not directly integrated into EPA or its memorandum as the main topic of EPA is quality of the living environment. However, ecosystem integrity is described as a part of quality of living environment. Ecosystem integrity refers to the ability of an ecosystem to preserve its components and functions in case of disturbance; in other words resilience and adaptability of the ecosystem (Speelman et al., 2007; TEEBweb.org). The relationship between ecosystem integrity and ecosystem services can be an opportunity to concentrate on ES concept in environmental policies (Zasada et al., 2017). As a result, referring to ecosystem integrity in EPA makes it possible to integrate the concept of ES into the governance of the living environment. EPA has six themes namely land, water, nature, cultural heritage, traffic and transportation. In particular, the first four themes can be potentially managed with an ES perspective while the effect of the last two on ecosystems should be recognized. Furthermore, establishing a balance for allocating functions to locations is an important aspect of EPA which an ecosystem approach can contribute to it. So, the right approach for ES mapping and evaluation can help local authorities to form a balanced and sustainable development plan (de Graaf et al., 2018).

Ede municipality has a population of over 113000 and area of 31862 hectare. Ede municipality is a partner of rural-urban Europe project (ROBUST) which focuses on exploring the lookout and restraints for rural-urban synergies in different parts of Europe. ROBUST aims to prompt potentials of local communities, promote sustainable food systems and pay more attention to multi-level and multi-actor governance. Among different themes of the

ROBUST project, Ede municipality focuses on sustainable food systems, ecosystem services and new rural business models in the region: as rural and urban areas can act complementary for bundling and balancing ecosystem services provision, new forms of urban-rural linkages can be created (Gutman, 2007; ROBUST, 2016; https://allecijfers.nl/gemeente/ede/ ; https://ede.buurtmonitor.nl/; http://rural-urban.eu/).

Establishment of IPBES with cooperation of 100 countries and two major projects in the EU are examples of increasing desire to translate the concept of ES into policy and practice (Hermenlingmeier and Nicholas, 2017). Despite increasing academic research on ES and growing desire of decision makers about ES, bridging the concept of ES into practice remains a gap (Olander et al., 2017). The municipality of Ede hopes to pay special attention on ES provision in design of new policies based on EPA. This would be also in accordance with the goals of the ROBUST in Ede, as mentioned before. However, finding the approach for ES mapping and evaluation and how to incorporate it into policies is a challenge. As a result, this study explores the prospects of incorporating an integrated ecosystem approach into municipal policies under the context of EPA, taking into account the opinion of local stakeholders.

2. Methodology:

2.1. Literature review and narrowing down the scope of research:

A literature review of different ES mapping and evaluation methods and indicators was carried out using keyword searches from Global scholar, Scopus and WUR library search. Using their bibliographies, additional articles were found. The findings were used to write a research proposal. Also, in order to explore EPA and the possibilities for ES provision, a thorough review on online materials and published articles on EPA was performed. Considering the broad range of topics in ES and EPA, the research proposal was shared with policy advisers of municipality of Ede. Then, the most important objectives and challenges of the policy writing team were discussed via personal contact with a representative of municipal policy makers involved in EPA. As a result, it was possible to narrow down the scope of the research. Further, the articles were examined based on: 1) to what extend the methods integrate biophysical and socio-economic aspects into one indicator and the limitations for this integration, 2) to what extent the indicators embrace both economic evaluation and non-economic evaluation of ES, 3) types of ES mapped and evaluated, 4) to what extent, the methods provide a practical and holistic view for policies of spatial planning. Based on this review, a handful of methods and approaches were selected to move towards a framework to advice policy makers on integrating ES into their policies based on EPA.

2.2. Interview with stakeholders:

Afterwards, purposive sampling of stakeholders and experts accompanied by snow-balled sampling was carried out for semi-structured interviews. The interviewees mainly comprised of policy advisors and program managers of different organizations involved with EPA and dealing with ES in the region, in addition to expert ecologist and cooperative representative. The main goal of interviews were to gather data on the opinion of stakeholders about priorities and challenges for implementation of EPA and their viewpoint on integrating ecosystem approach into EPA. The interview questions were formed to receive input and feedback for a theoretical framework to integrate ES into policies. Furthermore, the following topics were also discussed during the interviews: stakeholders' opinion on trend of ES supply and demand, types of available data and maps for each of these organizations and most importantly the environmental and socio-economic challenges that Ede faces. The latter was specifically informative to adapt the approach so it would be of practical use for municipality of Ede. A table with more detail on each interview can be found in appendix A.

2.3. Design of ES integrated land use policy framework and feedback from the municipality and expert ecologist:

Results of the literature review and 5 interviews were brought together to design a framework to advice municipal policy makers on how to incorporate ecosystem services into issuing permits for land use change. After receiving feedback in interview 6 on the first framework, a second framework was designed and both frameworks were discussed in interviews 7, 8 and 9. To give more structure to the frameworks, they were adapted to DPSIR which stands for five main elements: Drivers, Pressure, current State, Impact and finally Responses in form of policies. DPSIR portrays cause-effect relationship between these elements and is mostly used to investigate environmental problems and land use change and the dynamics around these issues (Havas et al., 2014; Kristensen, 2004).

It should be noted that conducting mapping and evaluation of ES in Ede were not part of this study but the main objective was to propose an integrated approach for ES mapping and evaluation. The literature review provided a more comprehensive outlook on different ES mapping and evaluation approach. However, it took quite a long time to scope down to the presented approaches and meanwhile less attention was given to evaluation methods in the final report due to the multiplex perspective on evaluation in BRIs (see section 3.3). Due to language limitation, all the interviews were in English and thus it may have excluded some stakeholders, particularly the requests for interview with agricultural policy maker and representatives of agricultural cooperatives remained without a response. In addition, exploring visions and programs of other Dutch cities and comparing their view with ones in Ede could be helpful for designing the frameworks, however, due to language barrier it was not possible. On the other hand, valuable information was gathered about EPA and how local stakeholders see it via interviews. Furthermore, interviews also provided an opportunity for local stakeholders to discuss these topics with someone outside their organization. In many cases, the interviewees expressed satisfaction with taking part in the interview as it helped them to look at EPA and their challenges from a different perspective i.e. the ecosystem approach. Hopefully, this can contribute to dialogue between different approaches to ES and EPA among stakeholders.

3. Results and Discussion:

3.1 What to value in an ecosystem approach?

Three different approaches towards ES are clearly present in the literature, which can be roughly categorized as non-utilitarian, utilitarian and methodological approach to ES evaluation. The first category is mainly focused on ethical aspects and is strongly against utilitarian approach towards nature. However, this category has a narrow view on utilitarian approach and recap utilitarianism as only monetary evaluation. The second category represent two groups: economic-utilitarian and non-economic utilitarian. Economic utilitarian is primarily focused on monetary evaluation of ES as a tool for decision makers. A non-economic utilitarian approach sees ES as a tool for conservation of natural capital and is against solely monetary evaluation of ecosystems while acknowledging the interconnections between ecosystems and the society. The last category in the literature is methodological approach which its main focus is methods and limitation on mapping and evaluation rather than fundamental perceptions of ES (Hermelingmeire and Nicholas, 2017). It should be noted that the non-utilitarian approach is quite limited in presenting a solution for increasing competition for land by different public and private stakeholders and the environmental and social problems generated by intensive use of natural capital while it can be the right perspective for existence value of some species. On the other hand, sole economic utilitarian approach is less likely to provide a holistic view on land use planning as it neglects the intrinsic value of nature on the wellbeing and cultural identity of the society according to IPBES. In addition, relying only on economic instrumental approach cannot provide a tool for management of ES with no-market value.

Considering the strong presence of instrumental valuation against intrinsic valuation of nature in ES mapping and valuation, IPBES suggests a third perspective on value which can bridge utilitarian approach to non-utilitarian approach. This perspective is “a relational value perspective” which highlights synergies and discords between human and nature as well as those within the society: values depicting our relationship with the nature as well as our responsibilities towards it (Figure 1). A relational value perspective introduces a value-pluralism approach which includes different biophysical, socio-cultural and health valuation approaches. Whether policy objectives are seen via the dichotomy approach or a value-pluralism approach, the policy design would be different (IPBES).

As each one of these values portray a group of interactions between ecosystem functions and ecosystem services as well as between ES and humans. In addition, these three types of values can represent the interests of different groups of the society so it can give a more comprehensive perspective for policy making. For example, a policy for encouraging grazing in intensive livestock production can be explored from different major approaches: Economic utilitarian view encompass the role of grazing to feed sufficiency, payment schemes for grazing and the financial aspects for farmers while a relational value highlights the contribution of grazing to the aesthetic of landscape for the public. Moreover, non-utilitarian perspective can contribute to animal welfare while non-economic utilitarian view can explore the role of grazing in soil organic matter and soil biodiversity. In addition, using all of these approaches can give a better view on dealing with externalities and coming up with alternative systems. Therefore, communication between different valuation approaches and considering all three types of values towards ES can provide a better tool for operationalization of ES for decision making. Considering the goals of this study related to helping sustainable spatial policy making, it is important to come up with indicators and a mapping and evaluation approach that potentially can take into account all of these categories.

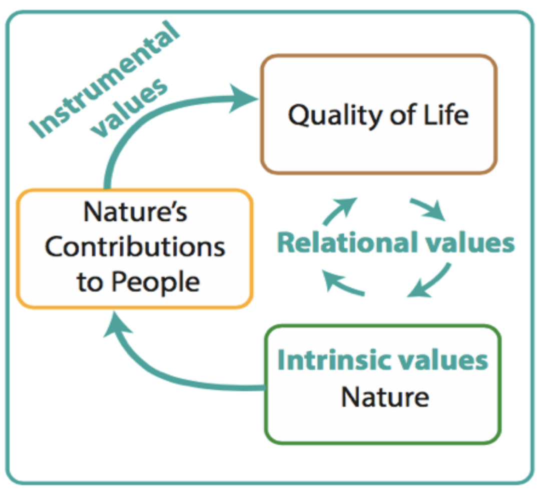

Figure 1. The relationship between different types of ES and the quality of life. Adapted from https://www.ipbes.net/contrasting-approaches-values-valuation

3.2. Towards an integrated indicator for mapping ecosystem services:

In the conceptual framework developed by Zasada et al (2017), landscapes are defined as socio-ecological systems comprised of socio-institutional and territorial dimensions (see appendix B). The first dimension highlights the role of stakeholders and the local community, their interests and preferences while the second one stresses the spatial heterogeneity in the capacity to deliver ES as well as demand for ES. In addition, the conceptual framework portrays the interrelations between policy, management and socio-economic benefits. Furthermore, both the dimensions affect and are affected by these three components. The link between policy, management and benefits makes this approach suitable for this study as it helps to have a more holistic view in finding the indicators which connect the different elements in this conceptual framework with focus on place-specificity. Furthermore, the three components are aligned with the topics that EPA wish to address in order to bring more sustainable benefits to the society (Zasada et al., 2017).

In order to delve more into an approach which is focused on ecosystem services mapping from a policy makers' point of view, Gulickx's approach (2013) was studied. This approach identifies difference between the ES mapping and evaluation for the academic purpose compared to a policy making use or land use planning. According to Gulickx (2013), the main differences are that planners are more focused on social aspects of ES. Another difference is that land use planners tend to map desired ecosystem functions for present or short term use while scientists tend to map only current ES to understand the spatial distribution of ES in the landscape. Gulickx (2013) suggests an approach integrating social factors into spatial indicators and the decision making process via participatory methods. However, it does not go further into designing more integrated indicators.

Functional Land Management (FLM) approach was explored as a recent approach for ES mapping and evaluation to advice decision makers. FLM fits into valuation methods which focus on quantifying the biophysical and ecological characteristics of the ecosystem (IPBES). In this approach, ecosystem services are reframed in soil functions which is used to map carbon sequestration, nutrient cycling, water purification, biodiversity and primary production. FLM can help policy makers to find the gaps and pathways to the desired scenario by supporting agricultural practices to strengthen particular soil functions for target locations. It is important to notice that while other land uses can be included in this approach, FLM is mainly focused on agricultural land use (O'Sullivan et al., 2017; Schulte et al., 2015). This can be a limitation for spatial planning that also include non-agricultural land uses, particularly under the holistic context of EPA. Despite, the strengths of this approach in soil quality, the boundary between ecosystem functions and ecosystem services in defining the indicators is not so clear. Furthermore, soil function indicators do not directly portray the social aspects. Moreover, the presence of an ecosystem function does not necessarily mean that it provides services because need or demand for a service can vary in different areas which can affect decision making process (Olander et al., 2017).

However, FLM offers three important features: 1) to identify the main narrative; the underlying reasons and drivers for current situation, 2) to translate the EU and National policies as demands for soil functions on local level and reflect the demands into advice on change in practices, 3) making maps showing supply of each soil function and maps illustrating the demand for each function in order to identify the spatial mismatches for each function (O'Sullivan et al., 2017; Schulte et al., 2015).

3.3. Benefit relevant indicators (BRIs) in the context of policy making:

As mentioned in section 3.2, an indicator which includes both biophysical and socio-economic aspects is more in harmony with the integrated and holistic approach that EPA pursuits. Benefit Relevant Indicators (BRIs) are a concept in economy that have been introduced to ecosystem services mapping and evaluation to reach a more holistic view in policy making. Benefit Relevant Indicators (BRIs) express how ecological changes are linked to relevant social outcomes. BRIs take into account what people actually value regarding an ES and its links with biophysical functions of the ecosystem. Also, it considers whether perceived value is in utilitarian, non-utilitarian or relational form. In addition, while designing a BRI, it is also considered which groups of the society have access to the service. As a result, it is necessary to define the "service-shed" or the target population in a BRI. Therefore, BRIs can help to bring down the scale to local level. In short, a BRI describes how a specific group of people will be affected by provision of a particular ES. As a result, BRIs can be used for integrating the social factors into mapping and valuation of ecosystem services as Gulickx (2013) recommends.

A crucial step for designing a BRI is the causal chain which is a three step conceptual illustration of how an action can change ecological functions, ecosystem services and the corresponding impact on the benefits for different groups of the society. These steps are what distinguishes BRIs for policy making compared to more ecological approaches. Through the design of the causal chain, the affected ecosystem functions and ecosystem services are separately recognized. These steps helps to distinguish the impact on the territorial dimension while the last step, shows how people will be affected by that change (Figure 2 a). The later a BRI is designed through the causal chain, the better indicator it is. Because it encompass more functions and services and therefore it is a more successful in bundling different ES. For example, a BRI based on change in the number of caught fish captures the final effect better compared to a BRI such as change in the population of the desired fish (Figure 2 b). Also, defining the causal chain and the target population can help suggesting clear actions for specific situations. For example, a BRI, such as the number of elderly residents that will benefit from a particular greening project, can be a proxy measure of the final ecosystem services e.g. climate adaptation (Olander et al., 2017; Olander et al., 2018).

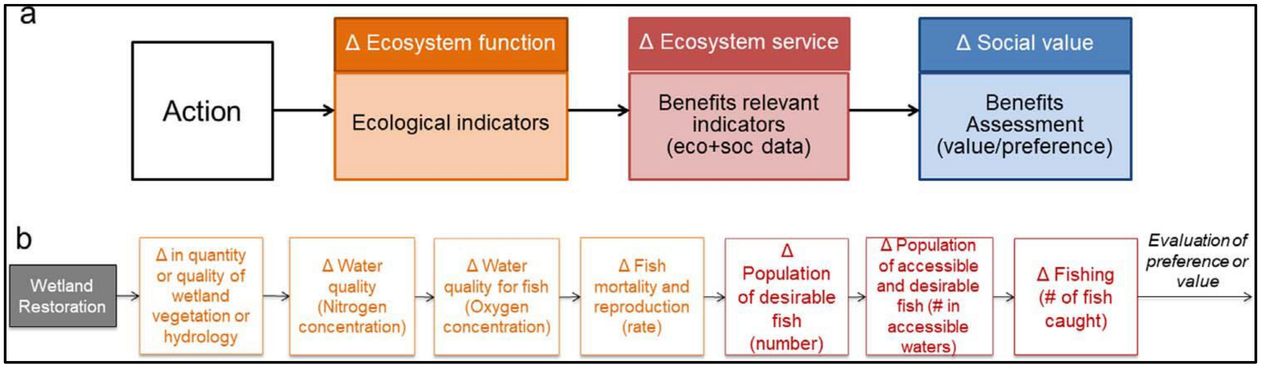

Figure 2. Causal chain for defining a BRI. a) BRIs distinguish between ecosystem functions, ecosystem services and final benefits received by people. b) an example of BRIs relevant to decision making for restoration projects of wetlands. Adapted from Olander et al (2018).

Moreover, based on the type of ES, BRIs can be the right indicators for either monetary or non-monetary valuation. If valuation is not possible or unwanted, a BRI can reflect ES and be the final step. An example of this can be conservation of biodiversity (Olander et al., 2017 and Olander et al., 2018). Above all, BRIs can express a more pluralistic view because all three types of values, as mentioned in section 3.1, can be used in designing the causal chain.

To design an example causal chain for Ede, potential cases such as climate adaptation, more environmentally-friendly agricultural practices and species protection projects were explored. However, missing links through the causal chain, particularly about the details of a possible action and not having access to all stakeholders were barriers in design of the causal chain (see section 3.6). Moreover, national and EU policies must be considered when designing a BRI, particularly in case of agricultural practices. Therefore, an actual project seemed a better candidate due to more available information as well as less diverse target population and location. Based on the interviews, an ongoing project in Ede to encourage residents to have less stone but more soil surface in their gardens was chosen to illustrate an example (Figure 3). This example was especially good to illustrate how decision makers can direct the causal chain considering their goals and possibilities.

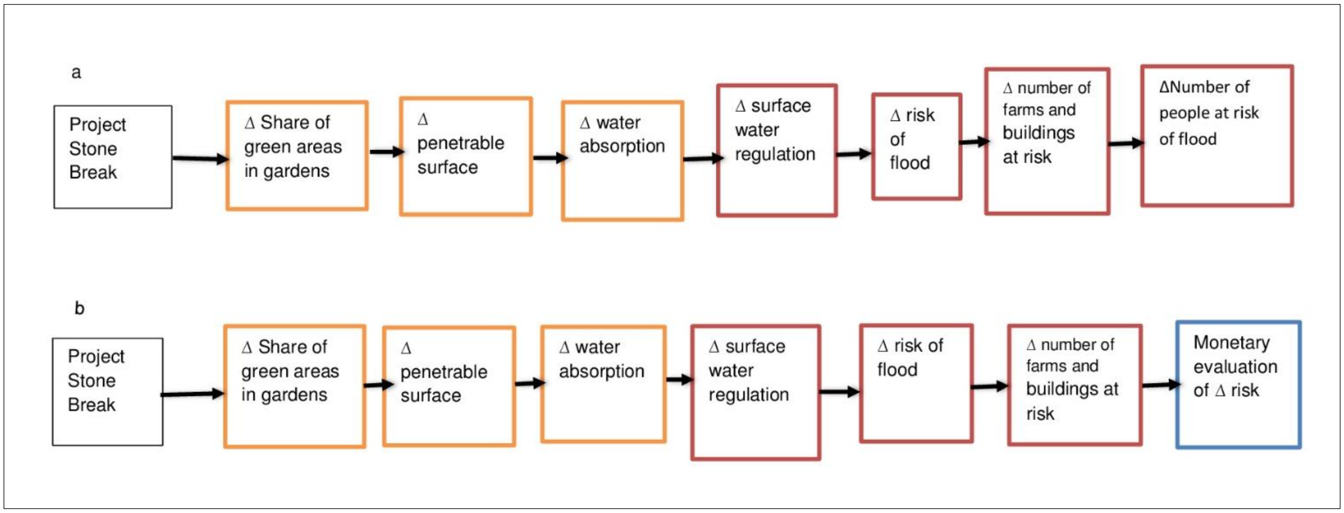

Figure 3. An example of causal chain in case of Ede. a) BRI defined in non-economic utilitarian perspective b) BRI defined in an economic utilitarian perspective for the same project. Colors of boxes represent the steps shown in Figure 2.a.

3.4. Tools and instruments offered by EPA

EPA tries to decentralize the management of the physical living environment and as a result, great deal of power and duty is assigned to the municipalities. According to EPA, municipalities are obliged to design an environmental vision i.e. de omgevingsvisie for the area under their authority. The vision illustrates the main perspective of the municipality for the physical living environment as well as the overall policies for the management of the physical living environment. Furthermore, the vision includes environmental values i.e. de omgevingswaarden, with a measurable outcome for an allocated time and location. In addition, relevant programs must be designed and implemented based on the objectives described in the vision. The programs contain a more thorough explanation of the policies, the goals, the current situation and the necessary steps and measures to reach the values within a timeframe for an area (own translation of EPA legislative). What worth noticing is the direction from the current situation to a desired situation in the design of the vision and the programs. An ecosystem approach can contribute to more clarity in the direction from current to desired situation by identifying the gaps between supply and demand for ES as described in FLM approach in section 3.2. As a result, ES mapping and evaluation can be very helpful for policymakers to have a more clear view on the gaps.

Furthermore, the municipality is mainly in charge of issuing permits for single activities or with cooperation with other organizations such as the waterboard in case the activity goes beyond municipal duties. As a result, a clear plan for accepting or rejecting permit requests need to be established (own translation of EPA legislative and EPA memorandum). According to municipal policy makers, Ede aims for a more flexible approach in issuing permits in order to support rural agricultural businesses and also attract non-agricultural businesses to rural areas. The ecosystem approach can contribute to more flexible permits by exploring synergies and conflicts from a more holistic lens. Moreover, place-based solutions are in core of EPA which makes an ecosystem approach more relevant. Also, emphasis on mitigating climate change and preserving the cultural heritage are other reasons to support an ecosystem approach with regard to EPA (own translation of EPA memorandum).

3.5. Integrating the concept of BRIs into Zasada framework:

To check whether or not the concept of BRIs fits with the view of Zasada et al (2017), BRIs were integrated into their conceptual framework. In addition, the role of the instruments stressed by the interviewees namely, flexible permits, new business models and raising awareness were incorporated in the conceptual framework (Figure 4). One major advantage of BRI is that it incorporates both socio-institutional and territorial dimensions into one indicator by use of the causal chain. Moreover, by designing the causal chain, one can explore who will benefit and who will not benefit in relation to a specific change in ecosystem management and land use. Also, in the causal chain, the effect of ecosystem functions and services on social benefits are discussed. Moreover, defining the target population and location integrates the socio-institutional dimension. This is mainly valuable as integrating socio-economic aspects into ES mapping remains a major challenge in many methods. The interconnection between policy and socio-institutional dimension in the conceptual framework also encourages participating stakeholders in design of policies. In addition, the connection between policy and social benefits is intrinsic in the definition of BRIs. This supports the claim that use of BRIs can contribute to a holistic view over the interactions between the ecosystem and the society.

Moreover, the interconnection between policy and territorial dimension recognizes the importance of identifying target location in order to take into account the spatial and scale mismatches in ES supply and demand (See appendix B). Furthermore, this interconnection also highlights the neighborhood effect on adaption of a policy, for example, the effect of farmers sharing opinions on new practices or business models with each other. In addition, figure 4 shows how policies can contribute to change in practices via communication and issuing permits. As a result, desired practices that contribute to the integrity of ecosystem can be supported. The combination of using causal chain, BRIs and protecting the integrity of ecosystems can give a better theoretical perspective on how the society will receive services or dis-services due to changes in the policies (Figure 4).

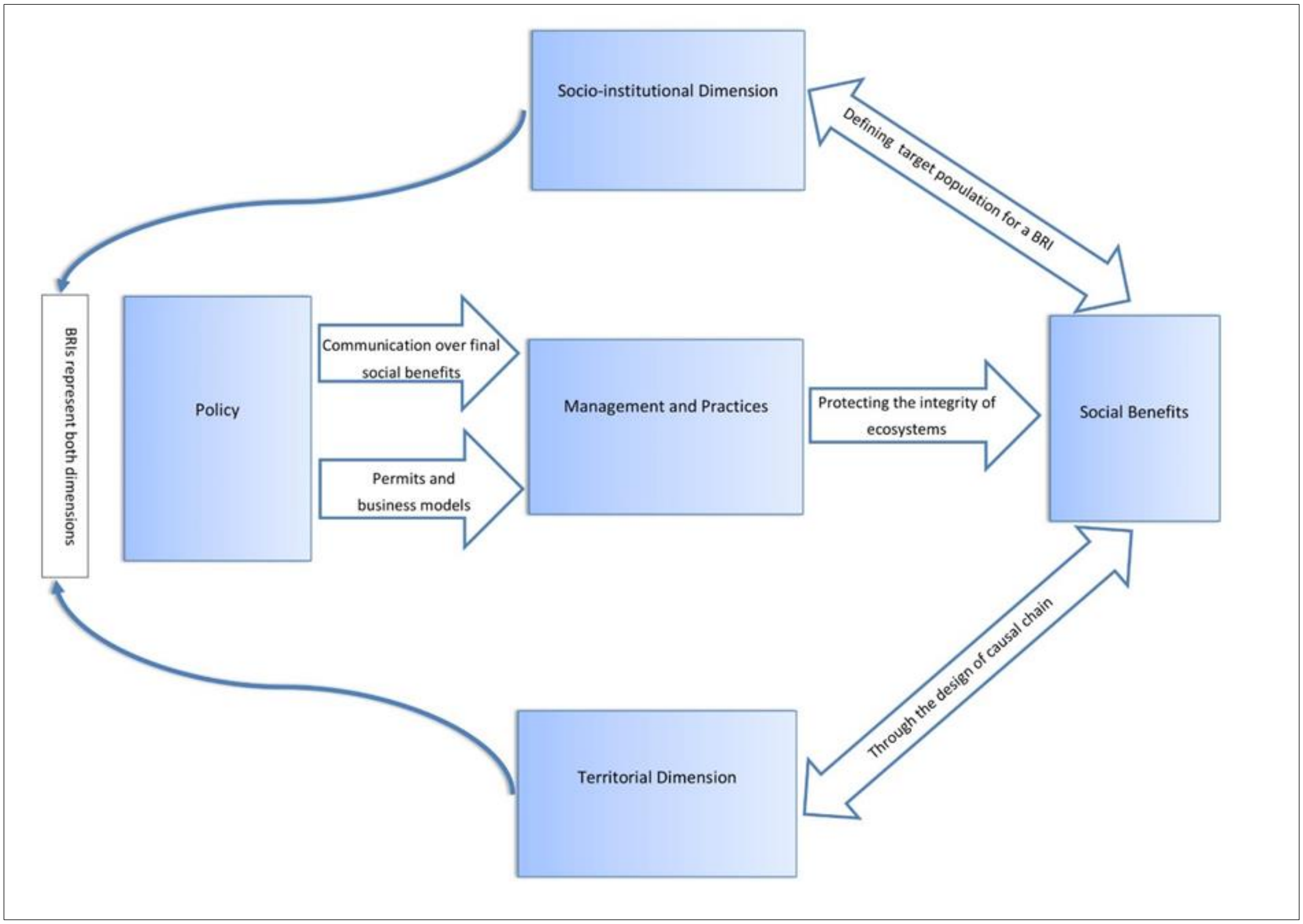

Figure 4. Integrating the concept of BRIs and the finding from the interviews into the Zasada framework (2017)

3.6. Frameworks for ecosystem services integrated land use policy:

EPA offers a great deal of flexibility to local policy makers on how to define the environmental values and write the programs. This flexibility can provide an opportunity to integrate ecosystem services into environmental values (de Omgevingswaarden) or program goals. The municipality sees ecosystem services as a tool to improve the living environment. Interviewees stated that ES can help to identify the goals, monitor the changes, recognize the conflicts, prioritize different locations and reach a multi-functional landscape approach. Furthermore, interviewed policy makers believed that the notion of ecosystem integrity in the EPA can be used for defining the values and program goals as de Graaf et al. (2018) suggest.

Two ES integrated policy frameworks (Figures 5 and 6) were designed trying to link vague terms such as good quality of the living environment with local decision making and to help operationalizing these terms into practice (de Graaf et al 2018). Moreover, these frameworks were an effort to illustrate a more practical aspect of ES in governance. Incorporating FLM approach and DPSIR methodology, the main drivers were identified using the environmental and socio-economic changes highlighted by stakeholders during the interviews. The most frequent and upstream changes mentioned by interviewees were selected as the main drivers and the consequences were defined as pressures in the frameworks (Havas et al., 2014; Kristensen, 2004; Schulte et al., 2015). Here, DPSIR was used to help system thinking and give a better chronological understanding of different steps suggested to policy makers.

Considering different tools in EPA, the first framework integrates ES into environmental values in the vision (Figure 5). The second framework integrates ES into program goals (Figure 6). The drivers and consequent pressure has led to current state. The current state in both frameworks is defined as writing the city vision and programs which starts from writing the vision, followed by defining the causal chain and BRIs. To design the BRIs, it is crucial to identify the involved locations and populations affected and involved by the specific action or project or change in practice or land use. As a result of designing the BRIs, the policy makers will have a map of BRIs at time zero e.g. present. The next part of the frameworks is the impact which portrays the effect of integrating ES into the attitude towards issuing permits. Finally, the response encompasses monitoring and feedback on the policies after a certain time. The feedback can result in adjusting and adapting the causal chain, the BRIs and their allocation to different program or the feedback can go all the way back to the vision as the upstream policy document (Figures 5 and 6).

Taking the emphasis on permits as an instrument for policy makers into account, the designed frameworks propose an integrated approach for more flexible permits (see section 3.7). The main feature of the frameworks is integrating ecosystem services mapping and evaluation into issuing permits via use of BRIs (Figures 5 and 6). By using BRIs, different ecosystem services as well as socio-economic aspects are bundled into one indicator via the causal chain. Therefore, BRIs can also contribute to a value-pluralism approach in perceiving the value of ecosystem services (section 3.1). Based on FLM approach (section 3.2), the frameworks can provide spatial data on changes in different BRIs in two points of time and therefore help decision makers in monitoring. The proposed frameworks are aligned with Zasada framework (section 3.5) in terms of covering the two dimensions of ecosystems and linking policies with practices and benefits for the society. In addition, ES integrated policy frameworks can contribute writing the city vision by taking the approach of BRIs and try to link land use change or preservation projects into societal effects. Also, using DPSIR methodology in writing the vision can help recognizing underlying reasons and different results of an action. Moreover, these frameworks can act as more practical tools in the vision and programs on spatial planning towards balanced and efficient allocation of functions to each location.

BRIs keep the space open for innovation and change in practices and land use as long as they do not harm the overall benefit of the service to the target population. This feature can contribute to more flexible attitude in issuing permits. On the other hand, alternative BRIs can be designed in case of major changes in land use. This can facilitate developing goals and the process of decision making. In addition, Use of BRIs can help to connect ES with the quality of life and to communicate the municipality goals with residents, tourists and other involved stakeholders (Olander et al., 2018).

Furthermore, ecosystem services can provide an insight into urban and rural synergies and tradeoffs while BRIs can help to understand the differences in benefits between urban and rural areas. In addition, permits with an ecosystem approach can provide more flexibility for public and private decision maker. Consequently, this can contribute to multi-level and multi-actor governance of the physical living environment. As a result, these frameworks can contribute to the goals of ROBUST in Ede by monitoring ES provision and incorporating ES into decision making process of issuing permits for businesses in rural areas and change in land use (ROBUST, 2016). Using both framework within EPA can help to reach an optimum in the distribution of different types of land use and connect rural viability with preserving the natural capital (de Groot et al., 2009; Gutman, 2007). Wide range of available maps, such as bio-morphological map, pdok, staatsbosbeheer, waterboard, NDFF, can help writing the vision and designing BRIs for different areas within the municipality. In addition, approaches such as FLM can help design of causal chain by providing information on ecological missing links.

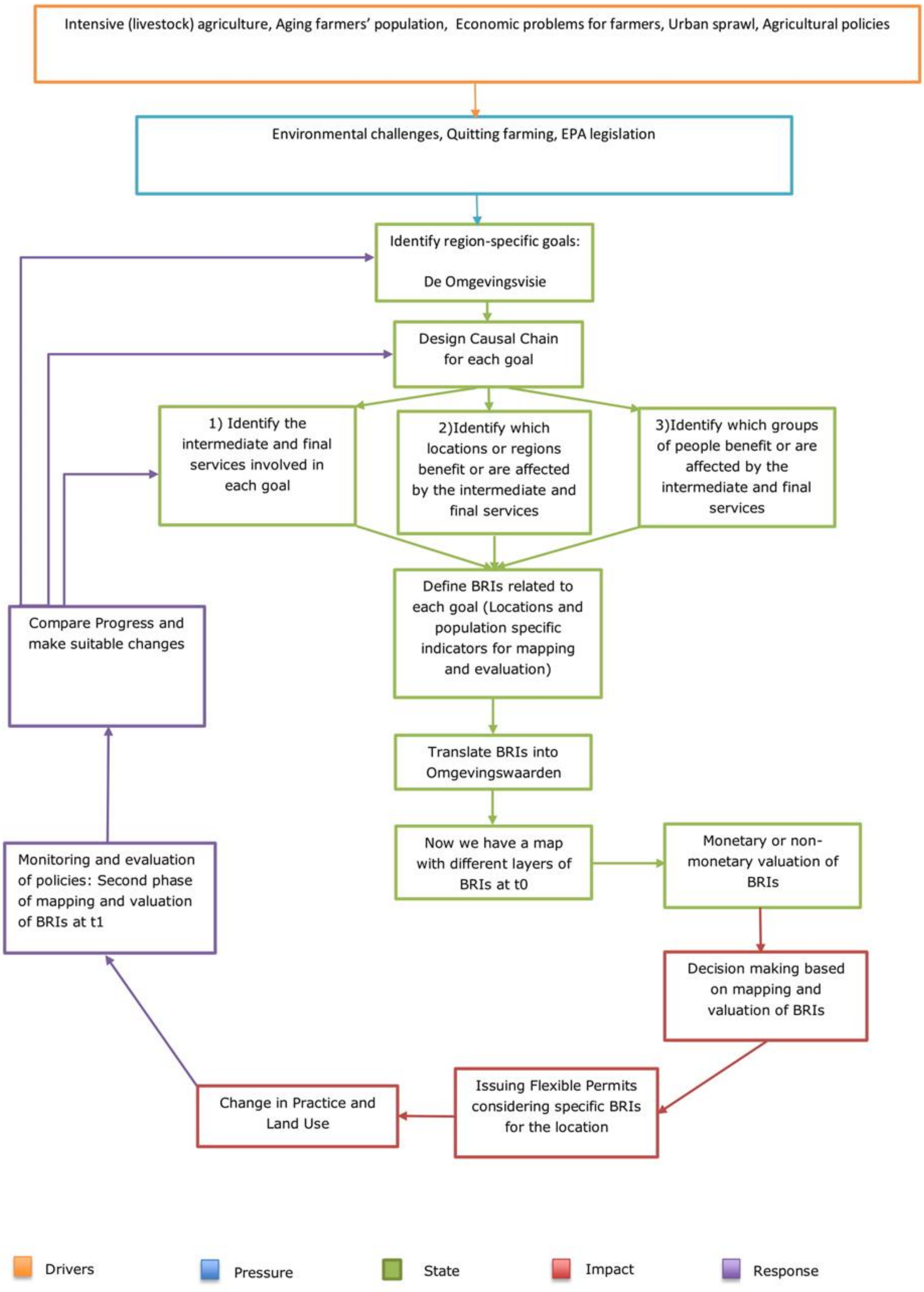

Figure 5. ES integrated land use policy framework 1: ES incorporated as environmental values within the vision

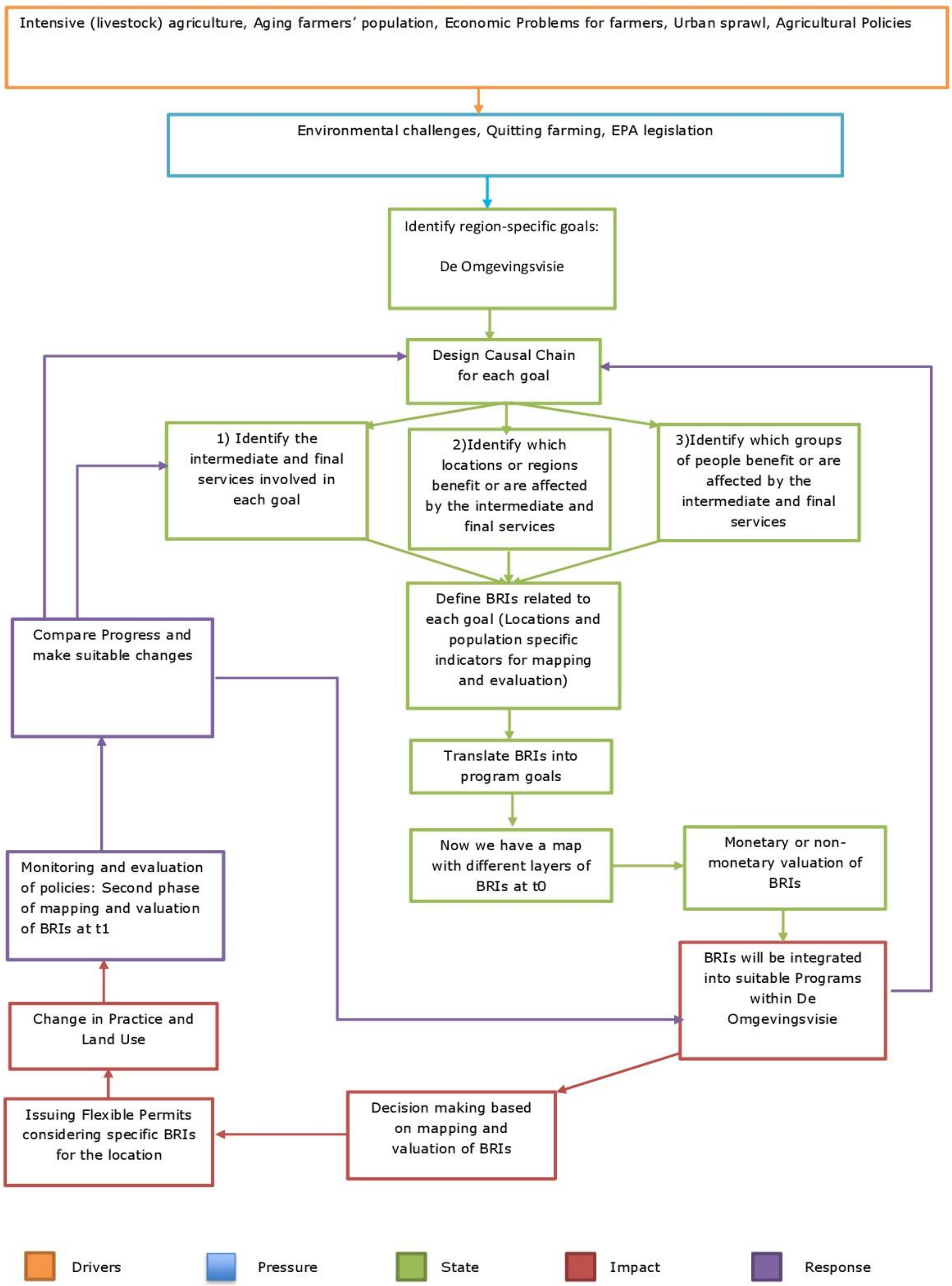

Figure 6. ES integrated land use policy framework 2: ES incorporated into program goals

Despite the broad academic studies, ecosystem services have rarely been incorporated in local landscape management and policies. Antognelli et al 2018 have identified three main barriers for this incorporation: the first barrier is the segregation between studies on urban and rural planning. The second barrier is scale mismatches between supply-demand areas and the planning regions as ES can act from global to local scale while the policy makers are focused on their administrative territory. So, mapping and quantifying ES that cover a larger scale can become impossible in relation to what extent they are under the responsibility of local authorities. The last barrier is that not every service benefit every citizen (Antognelli et al 2018). Use of BRIs can help to address these barriers. In relation to the first barrier, although this research is more focused on rural areas, the framework can also be used for semi-urban and urban areas. The second barrier is already recognised in EPA to an extent as there are three levels policy visions: national, provincial and municipal in addition to the blue vision by the waterboard e.g. blauwe omgevingsvisie. Furthermore, the scale of mismatches can be acknowledged in the municipal vision. To address the last barrier, use of causal chain in the framework helps to distinguish between intermediate and final services in relation to target populations and locations.

There are a variety of tools for ES mapping though maps generated from different tools can have major differences. These differences can be due to types of required data for each tool, the extent of being user friendly and the accuracy of the tools (Vorstius and Spray, 2015). Moreover, the interviewees with background in ecology were well aware that in any mapping and evaluation approach, monitoring, scale of the map and extrapolating will be major challenges. In addition, valuation methods are not only technical but also political as they can be influenced by decision makers' preference which in turn can affect the outcomes. In addition to the methods, interpretation of results are also subject to preference of authorities. As a result, thinking about clear reasons for decisions in their specific context can help to keep on track of the original values during the decision making process. Furthermore, the conflicting values and interests cannot be avoided and must be taken into account (IPBES). In case of Ede, having the main environmental values (omgevingwaarden) and program goals in mind can help to find a specific solutions for conflicting situation.

Use of BRIs has also its limitations. One considerable limitation is missing links in the causal chain which can be a barrier in defining BRIs. These missing links can include lack of data on ecological functions or their connection with ecosystem services which may need more research and inventing models. Also, there can be missing links about the effect of ES on societal benefit, demand for a service or how people value a particular ES. It is crucial to integrate both biophysical and socio-economic data, including information about demand for a particular ES, through the causal chain. Otherwise, the valuation of ES can become debatable. So, developing new evaluation methods might be needed. However, sometimes there is not enough information or literature for evaluation especially because most of ES evaluation articles are focused on case-specific studies with focus on methodology rather than providing a tool for policy makers. In addition, some valuation methods are not accepted by decision makers, particularly for nonuse values (Olander et al., 2017). More research and development need financial investment or cooperation with scientific institutes. These limitations can mean that BRIs cannot be used for all the actions.

3.7. Challenges in Ede and the role of EPA from the perspective of stakeholders:

The major agricultural activity in rural Ede is intensive livestock production (poultry, pigs, veal). To a less extent, dairy and crop production, mainly maize are other types of agriculture in this municipality. So, it is mostly farming systems characterized by intensive land use with less opportunities with ES provision. In Ede, the number of farmers is reducing, smaller farms are disappearing while the remaining ones are becoming more specialized. There is also growing number of alternative farming systems with interest in ES provision. These changes has led to empty farm buildings and a considerable gap between agricultural permits and actual practices happening in more pieces of land with agricultural function. For example, a former livestock farm has already gained the permits for this business. However, when a farmer quits the business, this gap can cause hindrance for change in land use and starting a new business or selling that land. These has led to a situation where there are lands with agricultural functions that cannot be transformed to other businesses despite the demand for land. According to interviewees, Ede deals with environmental challenges such as loss of soil organic matter, excess N from agriculture and traffic, biodiversity loss, drought and heat stress. In addition, water storage and purification and climate adaptation are other major problems.

Interviewees largely agreed that EPA is quite broad and open to interpretation. Besides, the range of topics in city vision can be also quite extensive so it is very important how the vision is translated into different programs. Moreover, cooperation between the local government, businesses and civil society to write the vision can be challenging. Furthermore, interviewees from the municipality, water board and forest management all stated that EPA requires change in the mindset of involved stakeholders as well as change in the internal administrative systems of the organizations. In addition, raising awareness among the city councils and residents about the importance of ecosystem integrity and its links with EPA were emphasized by the interviewees. Furthermore, the interviewees hoped that EPA can help to improve rural businesses and help farmers to come up with new business models and raise awareness on more environmentally-friendly practices. Interviewees also believed that EPA demands different organizations to work more closely particularly for issuing permits. Also, policy advisers in different organizations expressed that EPA can contribute better to addressing environmental problems if it is combined with monitoring and permits.

It seems what stakeholders have in common is feeling uncertain whether the implementation of EPA would lead to more harmony between stakeholders or more bureaucracy. In other words, there is a degree of confusion about how effective EPA would be for bundling different synergies and multi-actor governance. Besides, the interviewees were quite skeptical about a common digital platform for sharing information and keeping the information updated. Moreover, stakeholders point at other actors to an extent for the success of EPA. Understandably, there are higher expectations from the municipality to come up with a suitable city vision and programs for EPA. However, it looked like the stakeholders were mainly focused on their own responsibilities and interests which can hinder a more holistic lens. This can be another limitation for developing causal chain and a BRI. Despite the effort of EPA for multi-actor governance, still a common approach among the stakeholders is missing which can be expected considering the diversity of stakeholders in local level. However, in case of Ede, it seems that both the municipality and the waterboard have an approach for cooperation and sharing their views particularly with farmers.

Considering the challenges they face, stakeholders prioritize the following objectives for the vision: improving biodiversity, climate adaptation, climate mitigation, more sustainable and profitable agricultural systems and more viable rural regions. The interviewees believed that more awareness, flexible permits, new business models and considering the multi-functionality of landscape can contribute positively to these objectives. However, the municipality policy makers were well aware of the possibility of conflicts between different objectives as well as the importance of decision making with a long-term perspective.

Particularly for agricultural activities, current regulations are to an extent based on a notion of agriculture from the past. So, local policies should move towards more flexibility and recognizing synergies and conflicts. While there are less opportunities for ES provision, direct sale or tourist activities in intensive livestock production systems, focus on system thinking and circular economy can make these farming systems more sustainable, for example by supporting initiative to change the feed. In addition, contradictory developments such as falling agricultural activities and rising number of abandoned farm buildings can provide new opportunities for other businesses as long as they contribute to ecosystem integrity and rural landscape, for instance, by providing green areas and habitat. Therefore, new opportunities and prospects may be facilitated by EPA as a tool to orient the supply and demand of ES. For this, agriculture can particularly play an important role in supply of ES.

4. Conclusion:

EPA tries to advocate sustainable and place-specific solution for the environmental and socio-economic challenges which affect land use and put pressure on space and ecosystems. The main message of EPA is to move beyond functions in land use and towards the quality of the physical living environment. Aligned with this approach, two frameworks were designed to help the local policy makers for integrating ES into governance of the living environment. The main features of ES integrated land use policy frameworks are: 1) integrating ES into EPA 2) integrating socio-economic aspects into ES mapping and evaluation by use of BRIs 3) more flexible permits using the concept of ES and BRIs. These frameworks show that EPA is open to pluralistic valuation of ecosystem services and an integrated and multi-stakeholder approach to preserve the integrity of the ecosystem and the quality of living environment. In addition, these frameworks can contribute to understanding the socio-economic and ecological outcomes of policies.

It should be noted that designing BRIs cannot be done in a vacuum and needs effort and time in addition to participating different experts and stakeholders. Furthermore, the shortfall of knowledge on ES and the complexity of ecosystems and the interrelations with human society must me acknowledged. This research does not claim to address all the issues of mapping and evaluation of ES, however it is a step forward for having a better view for policy makers and to communicate their objectives in forms of benefits with other stakeholders. Finally, to mobilize the local potentials and make space for bottom up innovations, increasing awareness in the society and investing in positive urban-rural synergies can play an important role.

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7. Appendices:

Appendix A. The list of interviewees and the date of interviews

# Interview	Function	Date
1	Program manager at the waterboard (waterschap)	1-5-2018
2	Advisor at the municipality (Gemeentehuis Ede)	3-5-2018
3	Advisor at the waterboard	4-5-2018
4	Municipal program manager	15-5-2018
5	Policy advisor at State forest management (Staatsbosbeheer)	15-5-2018
6	Municipal policy advisor	31-5-2018
7	Agricultural advisor at Cooperative focused on ES	6-6-2018
8	Municipal program manager (interview for the second time)	12-6-2018
9	Ecologist (expert on biodiversity mapping)	18-6-2018

Appendix B. Conceptual Framework developed by Zasada et al. (2017)