

Sustainable Value Analysis: Sustainability in a New Light

Results of the EU SVAPPAS Project

Analyse de la valeur durable : Le projet SVAPPAS de l'Union européenne éclaire la durabilité sous un jour nouveau

Sustainable-Value-Analysis: Nachhaltigkeit in einem neuen Licht als Ergebnis des SVAPPAS-Projekts der EU

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In agriculture, as in many other industries, sustainability is a recurring issue – but one where agreement on a way forward has been difficult to achieve. According to the influential Brundtland Commission definition of 1987, sustainable production can be defined as production that meets the present needs without compromising the ability of future generations to meet their own needs. A core question for sustainability assessment is then: how to best fulfil these needs with a minimum of resources, or how to create maximum value with the resources used? Either way, it is not easy to quantify or measure sustainability performance. Methods have to be theoretically sound, easy to implement and understandable to stakeholders. Various assessment and monitoring methods have been developed, but few of them are used in practice for policy evaluation and design. The reason for this is that most methods are only burden oriented. This means that they aim at measuring the undesired impact of production, or burden, on the environment but do not look at the value created by the resource base. The Sustainable Value (SV) method, recently developed by Figge and Hahn (2004), starts from a different perspective and tries to assess sustainability performance based on the value that is created by resources used in alternative production processes. The method has already been applied to industry, as

illustrated for 65 European manufacturing companies in the ADVANCE project.

The objective of the 2007 FP6 STREP EU-project SVAPPAS (Sustainable Value Analysis of Policy and Performance in the Agricultural Sector) was to test, elaborate and apply this new method in the agricultural context. Another goal of the project was to evaluate the suitability of EU Farm Accountancy Data Network (FADN) data for SV analysis. This project brought Figge and Hahn, the original developers of the SV method, together with a multidisciplinary group of agricultural and ecological economists. This article summarises the main findings of the SVAPPAS project.

“ L’agriculture est un domaine auquel la méthode d’analyse de la Valeur Durable s’applique de manière satisfaisante. ”

The Sustainable Value approach: from burden to value oriented

The SV method offers two new perspectives with respect to conventional burden-oriented approaches. First, the method applies a value-oriented approach, which assesses and aggregates resource use



Potential nitrate leaching to adjacent river streams

and environmental impacts according to their effect on value creation rather than according to their actual burden (Figge and Hahn, 2004). While burden-oriented approaches focus on the question *if* resources should be used at all (including *how much* should be used), the SV method focuses on the question *where* the available resources should be allocated for the highest value creation (Figge and Hahn, 2004). In particular, the method assesses whether a reallocation of resources

between firms within a sector or region can increase the total benefit (e.g. products, services, profit, etc.) by using a given amount of resources.

Second, by integrating principles from financial economics, SV assesses resource use from the viewpoint of the investor or resource supplier (a private investor or the government), rather than from the perspective of the resource user (the firm), or casualty of resource use (the environment). SV focuses on value creation from the perspective of the

supplier who can allocate a given bundle of resources to different resource users. This perspective is closer to a perspective of common resource governance, which can be seen in most agricultural policies (e.g. allocation of subsidies, land management, quota, etc.).

Sustainable resource use as a concept

Understanding resource use is fundamental to clarifying the link between firms' production decisions

Box 1: The original SV method

The following dairy farm example illustrates the underlying principles of the SV method. The selected variables for natural capital are water use, greenhouse gas emissions per farm, N excretion per hectare and land use. The selection of these environmental variables covers some of the more important ecosystem sustainability issues. Fresh water is becoming one of the scarce resources of the future. Agriculture is moreover one of the main sectors contributing to global warming, with a prominent role for dairy farming, due to methane emissions from enteric fermentation and manure deposition. Nitrate pollution of aquifers is a major environmental issue, and the maximum allowable amount of nitrogen from livestock is set at 170 kg manure N/ha in the EU. Finally, land scarcity is important as agriculture is competing with nature and other land uses. The selected social capital form is labour. Manufactured capital forms are depreciated farm capital, which consists of buildings and machinery, and concentrate use.

The example farm consumes 1,770 m² water per annum and emits 499 tonnes of greenhouse gases (in CO₂-equivalents). Livestock on the farm excrete 121 kg of N per hectare. The farm uses 50 hectares of land, 5,074 hours of labour, €21,429 of depreciated farm capital and 290 tonnes of concentrates per annum. In turn, these capital forms yield a total of 396,200 litres of milk, for a total return of €118,860. These synthetic farm data are taken from the FADN database or are constructed based on data from the FADN.

First, the average farm productivities per capital form are calculated, expressed as total return per unit of capital (column B). For the example, farm average productivity of the capital form 'water' is €67/m². Then, the benchmark value needs to be calculated for all these productivities. In our example, this is the average productivity of a group of dairy farms included in the FADN database (column C, €161/m²). This provides a basis for calculating the opportunity cost for our example farm. The contribution of each resource to the SV (or Value Contribution) is then the productivity difference between the farm and the benchmark multiplied by the amount of the capital form consumed by the farm: $(B - C) \times A$.

Table 1: SV calculation of a Belgian dairy farm based upon the original SV formula

Type of capital form	Capital form	Measurement unit (m.u.)	Example farm	Average Productivity (€/m.u.)		Value contribution (€)	Sustainable value (€)
				Farm	Benchmark		
				A	B	C	$D = (B - C) \times A$
Environmental	Water	m ³	1,770.00	67.15	161.49	-166,981.80	
	CO ₂ -emission	tonne CO ₂ -eq.	499.21	238.10	255.08	-8,476.59	
	N-excretion	kg/ha	121.33	979.64	757.18	26,991.07	
	Land	ha	50.36	2,360.21	1,923.33	22,001.28	
Social	Labour	hours	5,074.00	23.43	19.03	22,325.60	
Manufactured	Farm capital	€	21,429.00	5.55	4.77	16,714.62	
	Concentrates	tonne	290.94	408.54	479.57	-20,665.47	
							-15,441.61

When the farm productivity exceeds the benchmark productivity, the farm creates SV and contributes to sustainability. In the other case the farm does not create or destroys SV.

Summing up all the farm's (positive and negative) value contributions and dividing by the number of capital forms used (7 in this case, to avoid double counting), results in the SV of the farm. Our example farm shows a total negative SV of -€15,442 for the farm.

and the sustainability of these decisions. For sustainability assessment, the set of traditional economic resources must be extended to the various forms of capital in the production system. These are natural capital (land, CO₂, water, ...), manufactured capital (buildings, machinery, ...), human capital (labour units, skills and knowledge), and social capital (social bonds, networks,...). The SV method uses this categorisation of resources into various forms of capital to assess where different resources should be invested for maximum value creation. In financial markets, capital is viewed as a scarce resource and therefore it should be allocated where its use gives the highest return. SV makes an analogous argument, not only for financial capital but also for other forms of capital.

“ Die Landwirtschaft eignet sich für die Anwendung der Sustainable-Value-Methode. ”

As the SV method includes social and natural capital, market prices are often not available or are ill-defined. This problem is overcome by using the opportunity cost as guiding principle. Opportunity cost refers to the value created by an obvious available alternative use of the capital forms under consideration. In SV, opportunity costs are determined from the viewpoint of the resource supplier. As in financial markets, the

opportunity costs of a resource's use by a particular firm are found by comparing the value created by that firm with the (weighted) average value created with the same resource at the aggregate level. This, depending on the investor's viewpoint, might be the market, the industry or the economy as a whole. Firms with a positive SV have higher than average resource use productivity and hence contribute to overall SV creation. Firms with a negative SV reduce the overall SV creation. As the method indicates which firms create more value than the average with the resources under consideration, the outcome of the method can be used to support resource providers in their aim for more SV creation. Box 1 illustrates the SV mathematical formulations using a tacit example.

Box 2: Incorporation of production functions

Incorporating production functions is one of the modifications to the original method. This modification ensures that the value creating potential of one resource is dependent on the other resources. The formulae originate from Mondelaers *et al.* (2010).

To illustrate the differences with the original method, we take the same example farm as discussed in Box 1. As column B shows, firm marginal productivities for a resource can be zero, indicating that no extra value is created when an additional unit of this resource is used by the farm. This is because other resources are limiting. The benchmark productivities are similarly defined, they also take account of the fact that some farms are unable to create additional value when a particular resource is reallocated to them.

Table 2: Incorporation of production functions in the calculation of the benchmark productivities for the example in Box 1

Type of capital form	Capital form	Measurement unit (m.u.)	Example farm	Marginal Productivity (€/m.u.)			Value contribution (€)	Sustainable value (€)
						D = (B - C) × A		
				Farm	Benchmark			
A	B	C*						
Environmental	Water	m ³	1,770.00	0.00	1.42	-2,513.40	6,456.25	
	CO ₂ -emission	tonne CO ₂ -eq.	499.21	111.47	96.48	7,483.16		
	N-excretion	kg/ha	121.33	103.42	145.07	-5,053.39		
	Land	ha	50.30	499.15	389.65	5,514.42		
Social	Labour	hours	5,074.00	0.00	1.36	-6,900.64		
Manufactured	Farm capital	€	21,429.00	0.38	0.36	428.58		
	Concentrates	tonne	290.94	60.01	34.24	7,497.52		

*Average marginal productivity.

A first noticeable difference with the previous example is that the SV is now positive (€6,456), indicating that this farm contributes to the SV creation of the benchmark group. Some important shifts in Value Contribution occur compared to Table 1. The value contribution of water is now much less negative compared to the previous example, but this farm still underperforms relative to the benchmark farms. Per unit of CO₂-emission the farm creates more value compared to the benchmark farms. Similar arguments can be developed for the other capital forms. The main difference between both approaches is that by working with marginal instead of average productivities, the method now takes into account that extra units of one resource also have implications for the use of other resources.

Modifications of the original SV method

During the three-year SVAPPAS project, the original SV method as developed by Figge and Hahn (2004) was critically analysed, tested, modified and extended. The investor's perspective, based on financial theory, was challenged by the production economists in the project, who are more familiar with concepts such as firm sustainability and efficiency assessment based upon microeconomic principles.

Criticisms concerned the absence of theoretical production concepts, the choice of benchmarks, an absence of sustainability thresholds and risk aspects. The following four modifications with respect to the original SV method were formulated as part of the SVAPPAS project:

- **Modification 1:** The original SV method does not take the underlying production functions into account when calculating the benchmark productivities. This criticism is formulated and described by Kuosmanen and Kuosmanen (2009). The original SV

developers take the viewpoint of an investor who considers the firm as a black box in which capital is invested and return is created. In reality, however, a production function relates inputs (capital forms) with output (return). The first modification incorporates production functions in the original method. This results in more appropriate and realistic opportunity costs for each resource. In the modified approach, the production function of each firm in the industry is taken into account to construct the aggregate benchmark. Box 2 illustrates a simplified version of this modification.

- **Modification 2:** The modified method now allows for alternative benchmarks. This can be done through attributing different weights to each firm in the industry. One of the suggested alternative weighting schemes is based upon the firm's marginal productivities, or shadow prices. Shadow prices indicate the firm's ability to create extra return with additional units of capital and thus their willingness-to-pay for extra

resource units (Mondelaers *et al.*, 2010). In another suggested weighting scheme, opportunity costs originate from the firm's peers that are located on the production frontier (Kuosmanen and Kuosmanen, 2009). This weighting makes it possible to switch from an investor's perspective to a manager's perspective, it provides an indication of how a firm manager can improve its value creation by applying the best technology available for his particular firm.

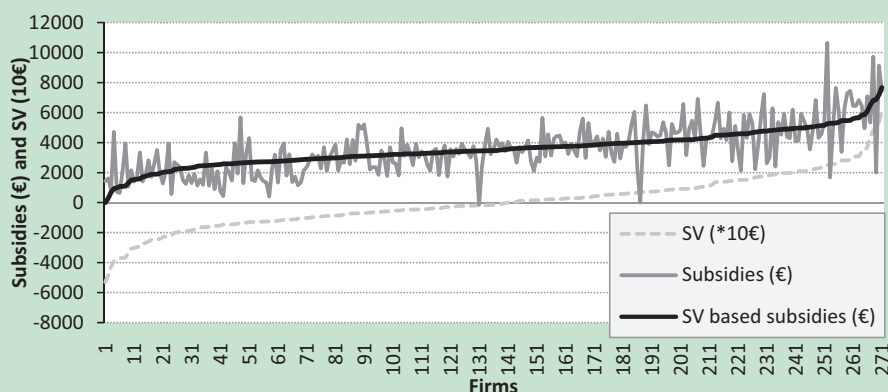
- **Modification 3:** SV calculations are based on current benchmark resource use, but this in itself may not necessarily be sustainable. Indeed, critical stocks of capital may become depleted due to overuse. This can only be detected by burden-based approaches. Depletion of critical stocks may still continue after reallocation among users. The third modification therefore proposes incorporating sustainability thresholds on capital use. Incorporating such thresholds identifies the direction in which the industry has to move to create

Box 3: Example: Recalculating the dairy subsidies of Belgian dairy farms based on SV

As an example of a possible application in practice, the modified SV method including production functions is applied to a sample of 271 Belgian dairy farms in 2004, derived from the EU FADN data (provided by European Commission, DG AGRI). The same capital types are included, as explained in Box 1.

Firms are ranked according to their SV scores (the dotted line in Figure 1). The firms to the right of the zero point on the horizontal axis contribute to SV creation, while those with a negative value destroy SV. Based upon these SV scores, the subsidies paid to dairy farmers (dairy premium + additional dairy subsidies – super levy) are redistributed. The farm with the lowest SV-score does not receive any subsidy, while the others receive subsidies according to their relative SV-score. Figure 1 shows the shift in farm subsidies when the same amount of subsidies is allocated based on SV rather than on the current decision rules (fluctuating line).

Figure 1: SV-score (in 10€) of Belgian dairy farms in 2004 and change in farm dairy subsidies when SV is used as calculation base for redistribution of subsidies



maximum value while simultaneously respecting the principle of sustainable resource use. The SV is then calculated, taking this direction into account (Mondelaers, 2010). A modelling application at farm level combining the SV approach with a set of environmentally sustainable thresholds appears in Merante *et al.* (2010).

- *Modification 4:* The comparison between the return of an individual firm and the average return of the market implicitly assumes that all companies involved are exposed to the same degree of risk (Figge and Hahn, 2007). This assumption can be relaxed by calculating risk-adjusted opportunity costs, i.e. opportunity costs that have the same level of risk as the company that is being evaluated. Figge and Hahn (2007) have developed a methodological framework that has (in adapted form) been tested and applied by Van der Venet *et al.* (2010) in an assessment of the sustainability of Flemish pig production.

Practical use for policy analysis

The SV method can be used both for **policy assessment** and **policy design**. The impact of different policy scenarios, such as a reduction in nitrate excretion or in greenhouse gas emission, on SV creation, can be assessed. This facilitates the comparison and evaluation of different policy options. The potential use of SV in **policy design** is illustrated in Box 3. The example shows how subsidies paid to dairy farms could be based upon an SV score rather than on the more traditional coupled and decoupled payment systems we are familiar with. As such, the SV method can be seen as a kind of ‘value for money’ approach, and thus could form the basis of further reflections on the potential for sustainability performance linked policies. During the project, various applications and tests of the method’s usefulness for policy analysis were developed (see project website or Kleinhanss *et al.*, 2010). Although these tests were designed principally to test methodological extensions, they also

indicate the scope of possible practical applications.

An important aspect of sustainability assessment is how to translate societal sustainability concerns into proxies for which data are easily available. The project team reflected extensively on the definition of resources and data availability. Sustainability concerns have to be translated into resource consumption at the firm level, which is a

“ Agriculture is a suitable arena in which to apply the SV method. ”

challenging exercise. In the SVAPPAS project, various frameworks were tested for their suitability. To apply the SV method at farm level, easily measurable proxies for societal sustainability concerns are needed. The proxies used must be sufficiently accurate to correctly differentiate the use of critical resources by individual farms. Given that the EU FADN data have been developed for economic accounting purposes, the SVAPPAS project tested its suitability for delivering proxies. Although rich in data, EU FADN shows some important limitations, especially for the construction of natural and social capital resource proxies. In general FADN data proved suitable for a first screening of SV at the European, national or regional level. For particular questions or in-depth farm analysis additional or more reliable data need to be collected, either

using the Life Cycle Analysis (LCA) technique (e.g. the Swiss example, Jan *et al.*, 2009) or by other methods. The challenge to environmental and ecological economists will be to link spatial databases of environmental data with economic databases and then proceed to examine sustainability questions empirically.

The potential of SV

The SV-approach is, due to the underlying value orientation of the approach, complementary to burden-oriented approaches to sustainability analysis. The SV estimates obtained can be used by investors to gain insight into the value creation differences in the current market; by managers to better utilise their resource bundle; and by policymakers to steer resource use in a direction that creates more value, by adapting regulations and economic instruments (taxes and subsidies).

The SVAPPAS project confirmed the potential of SV when applied to agriculture. The applications and tests within the project showed that the sector, with its large amount of available data and many sustainability challenges is a suitable arena in which to apply, test and further improve the method. Proposed modifications extended the original investor perspective by using ecological, economic and production principles. These modifications in combination with the original investor perspective make the method well-suited for policy assessment and design. The introduction of firm-specific production functions in the benchmark calculation makes the



Positive landscape externalities of agriculture

method better suited to the comparison of heterogeneous firms operating in different socio-ecological settings. The capital use thresholds make it possible to take into account differences in sustainability issues with spatial impacts, such as the problems of nitrate pollution and greenhouse gas emissions. By changing the weighting of the different firms in the benchmark, it is easy to switch between the private investor's view, the manager's view and the policymaker's view. As suggested by Ang and Van Passel (2010), further developments in the methodology would include a more systematic selection of indicators (capital forms), with a special focus on the integration of more intangible social capital indicators; on the

consideration of the whole value chain instead of a strict firm level focus; and on the further inclusion of the SV-method in policy models.

As coordinators of the project, we therefore hope that the project findings stimulate further debate, research and applications with respect to sustainability issues within agriculture.

Notes

1. This article has been written by the coordinators of the SVAPPAS project in order to disseminate the findings of the project. It does not necessarily reflect the opinion of all contributors to the SVAPPAS project.

2. Project partners include: UGent (Belgium), ILVO (Belgium), QUB

(UK), IZT (Germany), vTI (Germany), ART (Switzerland), AKI (Hungary), UNIFI (Italy), MTT (Finland).

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summary

Sustainable Value

Analysis: Sustainability in a New Light
Results of the EU SVAPPAS Project



Most sustainability measurement instruments apply a burden-based perspective, with a focus on reducing negative environmental impacts. The Sustainable Value method offers two interesting new viewpoints. First, a value-oriented approach to impact assessment is applied. Second, Sustainable Value assesses resource use from the perspective of the resource provider (the investor), rather than from the perspective of the resource user (the farm manager), or from the perspective of the casualty of resource use (the natural environment). The method compares the value created by a firm with a set of resources with the opportunity cost of the resources used, this being the value created by an appropriately chosen benchmark. The FP6 STREP EU-project SVAPPAS (Sustainable Value Analysis of Policy and Performance in the Agricultural Sector) tested, elaborated and applied this new method in the agricultural sector. The project also checked the suitability of the EU FADN (Farm Accountancy Data Network) data for Sustainable Value analysis. Various modifications to the original method were suggested, such as the incorporation of production functions to calculate the benchmark opportunity costs. Further, extensions of the method for policy assessment and policy design were investigated. By doing so the project provided another lens to sustainability that may complement existing paradigms.

Analyse de la valeur durable : Le projet SVAPPAS de l'Union européenne éclaire la durabilité sous un jour nouveau



La plupart des instruments de mesure de la durabilité s'intéressent aux coûts et se concentrent sur la réduction des incidences environnementales négatives. La méthode de la Valeur Durable offre deux nouveaux points de vue intéressants. Premièrement, elle adopte une approche orientée sur la valeur pour évaluer les incidences. Deuxièmement, la Valeur Durable évalue l'utilisation des ressources du point de vue du fournisseur des ressources (l'investisseur), plutôt que de celui de l'utilisateur des ressources (l'exploitant agricole), ou de celui des pertes en ressources (l'environnement naturel). La méthode consiste à comparer la valeur créée par une entreprise disposant d'un ensemble de ressources au coût d'opportunité de la ressource utilisée, qui est estimé par la valeur créée par une activité de référence appropriée. Le projet SVAPPAS (analyse de la valeur durable des politiques et des performances du secteur agricole) du 6ème programme cadre de l'Union européenne a testé, élaboré et appliqué cette nouvelle méthode au secteur agricole. Le projet a également vérifié si les données du RICA (Réseau d'Information Comptable Agricole) européen convenaient à l'analyse de la Valeur Durable. Diverses modifications de la méthode d'origine ont été suggérées comme l'ajout de fonctions de production pour calculer les coûts d'opportunité de référence. En outre, l'extension de la méthode à l'évaluation et la conception des politiques a été explorée. Ce faisant, le projet a donné à la durabilité une nouvelle perspective qui pourrait compléter les paradigmes existants.

Sustainable-Value-Analyse: Nachhaltigkeit in einem neuen Licht als Ergebnis des SVAPPAS-Projekts der EU



Die meisten Instrumente zur Messung von Nachhaltigkeit wählen eine kostenorientierte Perspektive und konzentrieren sich auf die Verringerung von negativen Umweltauswirkungen. Der nachhaltige Mehrwert, oder die Sustainable-Value-Methode, eröffnet zwei interessante neue Aspekte. Erstens: Es wird ein wertorientierter Ansatz zur Bewertung der Auswirkungen angewendet. Zweitens: Der Sustainable-Value-Ansatz bewertet den Ressourcenverbrauch aus der Sicht des Ressourcenlieferanten (Investor) und nicht aus der Sicht des Ressourcenverbrauchers (Landwirt) oder aus der Sicht dessen, was dem Ressourcenverbrauch zum Opfer fällt (naturbelassene Umwelt). Die Methode stellt den Mehrwert, den eine Firma mit einer gewissen Menge an Ressourcen schafft, in Bezug zu den Opportunitätskosten der verbrauchten Ressourcen; bei dieser Angabe handelt es sich um eine angemessene Vergleichsgröße. Innerhalb des EU-geförderten Forschungsprojekts SVAPPAS (Sustainable Value Analysis of Policy and Performance in the Agricultural Sector) des 6. Rahmenprogramms wurde diese neue Methode auf dem Agrarsektor erprobt, verfeinert und angewandt. Das Projekt hat ebenfalls die Eignung des Informationsnetzes landwirtschaftlicher Buchführungen (INLB) der EU für die Sustainable-Value-Analyse überprüft. Zahlreiche Vorschläge zur Änderung der ursprünglichen Methode gingen ein, z.B. die Implementierung von Produktionsfunktionen zur Berechnung der Vergleichszahlen für Opportunitätskosten. Zudem wurden Erweiterungen der Methode zur Bewertung von Politikmaßnahmen und politischen Konzepten untersucht. Auf diese Weise hat das Projekt eine andere Sichtweise auf Nachhaltigkeit eröffnet, die bereits existierende Modelle bereichern könnte.

summary