SIP-programme description

UrbanFood – Urban-industry related food production and supply systems

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1.1 Definition of the strategic innovation area

1.1.1 The Vision and the goals of the innovation agenda for the area

The vision of this strategic innovation agenda is a partial reorientation of current urban food supply, moving parts of food production closer to consumers. In this way, food for urban areas will to an important extent be supplied by globalized large scale production systems, but also by complementing production systems in and in proximity to urban areas. This new area of urban and industry related food production and supply shall be based on safeguarding food security, food quality and traceability, resource performance and animal welfare.

The goals of the innovation agenda are:

1. To gather important Swedish and later international actors in a joint effort to partly renew the way food and food components are produced and delivered to customers in urban areas;
2. To bring Swedish industrial actors in key sectors, such as energy industry, water industry, pulp and paper industry into the food production and supply arena and join forces with traditional farmers and food production industry;
3. To combine to a greater extent biological competence with technical competence in food production and in this way fertilize innovation in the food production sector;
4. To increasingly make use of surplus energy streams, industrial organic waste streams and urban rest products (e.g. organic waste, nutrients) to be recycled into the human food supply and in this way contribute to the establishment of a circular production system;
5. To bring parts of the food production closer to customers in urban areas, while using land efficient high-technology energy and resource efficient methods;
6. To increase the possibilities to control food production and supply an increasing part of urban food produced in systems independent of climate change, weather changes, needs for large areas of fertile soil and freshwater for irrigation.

1.1.2 Definition of the strategic innovation area

Key issues for the innovation area are: How can we assure a reasonable degree of security in food supply even at times of disturbances in the globalized system?

1. How can we improve food quality – such as nutritional value, taste, absence of infectious matter and chemicals?
2. How can we make food supply more resource efficient, i.e. eco-cycle oriented, minimizing food spillage and waste in a life-cycle perspective?
3. How can we safeguard a good animal welfare and a high ethical standard of food production in terms of social conditions for workers and other personnel?

Here, we foresee a partial shift of food supply to urban areas, where it will be partially re-oriented to take place in closer proximity to urban areas, involve a partial reorientation of protein supply from red meat to white meat and fish, take place in closed systems such as green houses and closed/semi closed aquaculture systems, and to an increasing extent be based on recycled organic components and nutrients from cities and industry.

The now proposed programme focuses on combining and improving increasingly important providers to the food supply system, namely, industrialized land based cultivation such as closed aquaculture systems, aquaponics and horticulture. The innovation area, however, is considerably broader (cf. Figure 1) and covers the entire food supply system to urban areas. Since this area has not been discussed in terms of an entire potential innovation area, by default it cannot become well-defined as many other agenda initiatives based in already established fields. However, the stakeholders gathered so far in this process all believe in the broader agenda and feel that it is possible to shape a strong point of departure for further work by preparing an initial Strategic Innovation Program named Urban-Industry Related Food Production and Supply in Circular Systems (cf. Figure 1).
1.1.3 The delimitations of the innovation area
The SIA (Strategic Innovation Agenda) deals with the challenge of food supply to rapidly growing urban populations all over the world. By natural reasons its focus during the first few years will be Sweden and Swedish conditions. Gradually, the international focus will be broadened, both with respect to capturing international knowledge and competence and in creating international cooperation.
In a first starting programme - the focus of this application - the main emphasis will be on production aspects and broad quality aspects. Here we will build a first innovation platform around the integration of three different sub-areas: (i) Aquaculture in closed systems, (ii) horticultural production and (iii) feed from rest product streams (for further details see below).

Already during the first three year phase of the programme, we will also devote strong efforts to the supply and consumption aspects of food supply. This work will be focused on consumer mobilization and mobilization of consumer oriented actors, such as municipalities. In continuing work, consumption aspects will be increasingly dealt with as an improved mobilization of consumers has been gained.

1.2 The innovation area in facts and figures
1.2.1 The innovation area’s current role in the Swedish Economy
The innovation area is very large and covers food supply to the main part of the Swedish population, with current numbers app. 85 % of the population living in urban areas. Calculated from the total Swedish population of 9.4 million inhabitants and with a monthly estimated spending of 1500 SEK/month and person for food, the gross turn-over of the area is 260-270 billion SEK per year, or 7-8 % of the entire national economy. The applicants behind this proposal estimates that 1/4 to 1/3 of the national food supply could be reoriented along what is outlined in this proposal, which would mean it could have a national turn-over in present numbers of 60-90 billion SEK/year. Since the challenges outlined in the agenda behind the proposal are of equal or higher relative magnitude in other parts of the world, the potential global significance is almost unmeasurable.

The start-up strategic innovation programme described in this application covers a part of the strategic innovation area and the present significance of the three key areas may be described as follows:
Aquaculture in recirculating systems, Swedish aquaculture and Swedish fish consumption

This area is new to Sweden and at the moment only a handful plants are in operation with a marginal total production of a few tens of tons per year. In total, approximately 20 persons work in the subarea at the moment. The interest is growing very rapidly and new plants are already emerging. A good example is the facility now being built at Björv, Skåne with biofloc farming of giant shrimp, planned to produce 100 tons annually and utilizing industrial waste heat and waste food from the local food industry. Using current market price, the production would indicate a retail value of 35 million SEK/yr.

Looking at the entire aquaculture industry in Sweden, there is a total production of between 12 000 and 13 000 tons per year, of which the main part is exported. The value of this production as a primary production may be estimated to 650 million SEK and at the consumer level to 1.3 billion SEK per year. These numbers could be compared to the total value of fish consumed in Sweden (150 000 tons per year at an average price of 100 SEK/kg) to around 15 billion SEK/yr. Since over 80 % of fish currently consumed in Sweden is imported, the significance of the industry for employment in Sweden is very low at present. Thus, there is a great potential for growth provided competitive aquaculture systems for Swedish conditions could be developed.

Horticultural production and horticultural products consumption in Sweden

At present, horticulture in Sweden represents almost 6 000 enterprises, where 270 ha of a total 50 000 ha are cultivated in a greenhouse environment. A greenhouse is several times as productive as open land systems per surface unit and with efficient energy solutions (heat and lighting) is able to produce year round also in Sweden. However in order to stay competitive many existing green houses in Sweden will have to be upgraded in the near future, both regarding system configuration and size.

Current primary horticulture production in Sweden represents a value of 7 billion SEK a year, where 70 % is food and 30 % non-food flowers. Of this, 70 % comes from open- and 30 % from closed (greenhouse) systems. The operations use 8 000 man-years (however often part time, i.e. around 14 000 employed) per year, with 40 % in closed systems. Open systems tend to practice seasonal employment more than closed systems, manifested by the fact that 60 % of personnel in closed systems work more than 900 h/year in the same employment, while in open systems employment is often less than 450 h/year. In parity with closed aquaculture production, horticulture is well suited for high intensity indoor production, being independent of weather and arable land, provided suitable nutrient and energy solutions are available.

Feed from the residual streams of unused organic material

Besides offering a more ethical production alternative, animal feed based on recaptured nutrients from food rest product streams also offers great possibilities for countries like Sweden. This is since the country has a high technology base and know how in biological and technical transformations. Let us consider fish feed alone. Based on a conservative FAO forecast, roughly 30 million tons of pure high quality protein will be needed by 2030 to satisfy the global market for aquafeeds. Such protein is presently available at the global spot market as LTD (Low Temperature Dried) fish meal and soy concentrate, where protein per ton was priced above 3 000 USD in late 2014. Even if prices fluctuate from time to time, it is expected that the long term trend is an increase in feed prices on the commodity market. We expect this trend to be further emphasized with the increase in global population and that feed from rest product streams will become even more important and interesting in the future.

Research to develop methods for production of high quality feed protein and oils – as a basis for future aquafeeds - from microbial and insect cultivation - using food waste and manure - is ongoing at the Swedish University of Agricultural Sciences (SLU). These products can later be used as a basis for aquafeeds or directly as food or feed. No real full scale production of feed from rest product streams exists, however, at the moment.
From the situation described above, it is clear that the overall present significance of the sub-innovation area of the SIP and the three sub-areas comprising the starting point for the SIP is small. Only horticultural production plays a significant role at the moment.

1.2.2 Strong Swedish actors in the innovation area
There are many driving forces in this area, ranging from industry and primary production to the consumer and the scientific community. The international food processing company Findus, is very active in the area as they foresee an increasing need of locally produced raw materials with high control, transparency and traceability for the customer, and of high ethical quality. The Federation of Swedish Farmers (LRF) has an interest and responsibility as the leading Swedish representative of Swedish primary food production. LRF has also, since its start, represented Swedish animal feed industry and recently adopted horticulture as one of its divisions (LRF Trädgård). LRF is now considering to do the same with the Association of Swedish aquaculture farmers (see Macklean report Dec. 2014).

In Sweden the main part of research concerning primary food production is concentrated to the Swedish University of Agricultural Sciences (SLU), with more than 90 locations all over the country. The campus located at Uppsala represents competence in food safety, ecological and traditional farming, animal husbandry including aquaculture, feed/nutrition, health and other veterinarian competence as well as food science. In fish biology, especially marine species, Gothenburg University has a high competence. In horticulture the SLU campus at Alnarp is central with a world leading competence and is together with activities at KTH the centre of Swedish competence in aquaponics. Sweden has a long tradition in animal feed production in companies such as Lantmännen, but due to a small domestic market in fish, these companies have either focused on terrestrial animals or, as in the case of the former Swedish feed company EWOS, moved to other markets. However, the programme management for the SIP has an ongoing contact with major international feed companies like EWOS, BioMare and Rasio, to mention a few.

In engineering of high technology systems like closed aquaculture, microbial production, water purification and energy transfer, Sweden has strong competence, both in industry, consultancy and academy. The Royal Institute of Technology (KTH) and its department for sustainable development, environmental science and engineering has a strong focus on industrial ecology and urban development, relevant for this SIP. Other academic institutions at e.g. Chalmers, Uppsala, Lund and Luleå are strong in technologies such as water purification, energy systems, fermentation, competencies that are all relevant for a successful development of closed systems for food production.

1.2.3 Important infrastructure assets in the area
Ongoing activity includes at present (i) a test bed for recycling aquaculture (RAS) at Ljusterö associated to KTH and another small RAS with Scandinavian Aquasystems in Tollarp, (i) a test bed for Biofloc under construction in Uppsala (farming in water with natural microbial ecosystems) associated with SLU and (iii) three small aquaponic systems - one at Alnarp, one at Härnösand and one at KTH, Stockholm. In this subarea of the programme, the emanating SIP management has strong links both to the Nordic RAS network (with the national representative at Chalmers, Gothenburg), with the RAS research stations at Sunndalsöra, Norway (NOFIMA), the DTU (Danish Technical University) research station at Hirtshals and the RAS research centre at Kiel University, Germany. It also has close contacts with our fellow research groups at the Norwegian University of Life Sciences, at NOFIMA, at The Institute of Marine Research and at NIFES, Norway.

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1 Svenskt vattenbruk, Möjligheter & utmaningar med en gemensam branschorganisation för det svenska vattenbruket samt förslag på organisation & finansiering, 20 December, 2014, Macklean AB
2 National Institute of Nutrition and Seafood Research
1.2.4 Intellectual resources

Sweden has a long history of good intellectual resources and high quality research. The high level of intellectual resources at SLU and KTH has frequently been demonstrated and both rank high in a European context. Furthermore, strong resources outside these two universities have contributed to the SIA work and the elaboration of this SIP proposal, including a multifold of industrial partners, local governments (municipalities and county governments), research institutes, NGOs and others.

Two important Swedish intellectual resources – recognized worldwide – are the Stockholm Resilient Center at Stockholm University and the Beijer Institute at the Royal Academy of Science. These centres address global challenges from both an environmental and national economic base. A future connection to these two institutions could further strengthen the main platform that the current SIP proposal rests on – global sustainability challenges.

The SP concern has taken part in this SIA and SIP work, represented by the division of Chemistry, Materials and Surfaces. SP represents an important Swedish intellectual resource, representing combined applied and basic research of potential value to the proposed programme. Since 1 January 2015, SP has acquired the former Swedish Institute for Food and Biotechnology with important competence and we hope to deepen the contacts with SP in the future development of the programme.

NGO’s like SNF (contact Ellen Bruno) and WWF (contact Inger Näslund) also follow the work and represent intellectual resources, but SNF has made an active principal decision not to be a direct member of programmes like this one in order to maintain full independence. WWF Sweden does not have such limitations, but does not have a representative in this specific area. Our programme, however, touches their activities related to Marine and Aquaculture Stewardship Council (MSC and ASC) and other activities directed towards sustainable cities.

1.2.5 Existing financing

National funding in the SIP area - closed production systems and alternative feed sources - exist both at Formas and Vinnova, who support individual projects including agri-, aqua- and horticulture. Lately, a new four year programme has been launched, combining efforts from Formas, with the research foundations Mistra and the Farmers Foundation for Agricultural Research. This programme also aims at integrating agri-, aqua- and horticultural production.

In addition, there are small internal projects funded by universities like SLU, GU (Gothenburg University), Chalmers and KTH, where individual researchers try to initiate cooperation over disciplinary boundaries. Small individual initiatives are sprouting also at regional levels, like feed mussel farms in the Baltic, development of RAS for pike perch and turbot, aquaponics for perch, etc. The list could be made longer but none of these initiatives are long term or interdisciplinary, i.e. a national unifying initiative is needed if these activities will be able to produce synergy and reach the critical mass needed to make the necessary impact for growth.

An important parallel programme to the one we want to initiate is the SEAFARM project, a so called blue growth initiative. The project has a total national funding of approx. 50 MSEK during 5 years and the aim is to use sea areas around Sweden (and elsewhere) for primary production of raw materials based on macro algae for e.g. the material industry, the food industry and the energy industry. Similar to the present initiative, SEAFARM is built on an eco-cycle thinking, where the development of circular production systems is of special interest. The close relation between the UrbanFood and SEAFARM initiatives is indicated in Figure 1, where UrbanFood is presented as a parallel activity to SEAFARM.

1.3 International position and competition

1.3.1 International actors and international competition

The international arena in the food production and supply sector has seen a very rapid vertical and horizontal integration in the last few decades. The international food and beverage companies have become very big. As an example, 10 of the biggest international companies (such as Nestlé, Unilever
group, PepsiCo Inc and Coca Cola Company) together employed 1.4 million people in 2012, had an annual turnover of over 400 billion USD per year and a net profit of over 40 billion USD per year (Oxfam 2013).

The rapid globalization of food production and supply has resulted in a successful increase in food supply all over the world. Despite a very rapid population increase the average global human has more food to eat and a greater variety of food to choose from than ever before.

Less discussed disadvantages of the rapid globalization are (i) an increased use of land, previously providing non-accounted for ecosystem services, (ii) increased use of water, (iii) increased use of fertilizers and chemicals (iv) production under less strict environmental regulations and control than in other countries and (v) production with a questionable ethics regarding production and human and animal welfare. These drawbacks have until recently been discussed very little in e.g. Sweden.

From a Swedish perspective, the current situation has resulted in that primary production is rapidly disappearing, moving to other countries with lower salaries and less strict regulations. This development connected to other structural changes in the Swedish society, has resulted in an increasing fraction of the population living and working in urban areas – today only app. 2 % of the Swedish population work in agriculture.

1.3.2 Important international research actors in the area

The CGIAR (started 1971 as Consultative Group on International Agricultural Research) Consortium is perhaps the most recognized international actor in food research and innovation. It is an international organization with the vision to reduce poverty and hunger, improve human health and nutrition, and enhance ecosystem resilience through high-quality international agricultural research, partnership and leadership. Today, CGIAR comprises over 60 countries and members and run 15 international research centres. Sweden is a member of CGIAR.

In addition there are a number of smaller initiatives, such as WorldFish, Science foundation, Eureka. In networking, Cost is an important player in food and agriculture, including aquaculture. At present 5-6 Cost actions are directly relevant for the programme.

EU is becoming an increasingly important actor in global research. A search on the EU home page (EU 2105) early February 2015 revealed that there are 93 on-going large food projects, spanning over a very large field of interest. Going through this list it was obvious that the programme proposed in this application is by all means broader in scope than any of the 93 EU projects and yet very concrete and focused on the three subareas. It is also interesting to note that a rather high number of the European projects (approx. 20) could potentially feed valuable knowledge into our programme.

1.3.3 Large international programmes

FAO’s Aquaculture Branch Fisheries and Aquaculture Management Division together with other FAO units like CFS (Committee on World Food Security)\(^3\) has formulated a joint goal of 50 million more farmed fish until 2030 (i.e. a total global production of 110 million ton of farmed fish) as a part of their Blue Growth initiative. FAO predicts that this must happen through a sustainable intensification, mainly of inland systems.

In order to support collaboration between national and international organisations towards this goal, FAO has established the collaboration platform, GAAP (Global Aquaculture Advancements Partnership). Our SIP has a personal invitation to participate in this platform by Rohana P. Subasinghe (Chief Aquaculture Branch Fisheries and Aquaculture Management Division) at a meeting at FAO, Rome 14\(^{th}\), October 2014. This network also includes a direct contact with other major initiatives of international bodies both within EU and globally.

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\(^3\) See also HLPE rapport no. 7. Sustainable fisheries and aquaculture for food security and nutrition, June 2014 and report from CFS 2014/41/3. POLICY ROUNDTABLE ON SUSTAINABLE FISHERIES AND AQUACULTURE FOR FOOD SECURITY AND NUTRITION from CFS 41, Fil CFS-a ml201e
The Global Challenge University Network is a SLU initiative that includes aquaculture aiming to form strong international networks meeting the central challenges of this SIA. KTH has similar alliances where e.g. strong links to China are of high international relevance for the SIA.

1.4 Global challenges or developments that affect the innovation area

1.4.1 Global challenges affecting the potential of the area

In discussing global challenges affecting the area and factors to consider, we have adopted a definition where challenges are overarching phenomena and factors are more specific and detailed aspects to consider.

The main challenge identified in our agenda is to feed a doubled urban population on earth within 30-40 years without destroying important ecosystems and/or causing social unrest. In trying to meet this challenge, a number of other important challenges will affect the possibilities to reach a positive outcome of our ambitions to meet the main challenge.

Such challenges within the innovation area are plentiful. Among the most important are: (i) to counteract global, regional and local variations and changes of weather and climate, (ii) to maintain international political stability, (iii) to foster global, regional and local economic development, (iv) to foster technical and social development and (v) to combat environmental impacts and threats. The suggested innovation area will influence these challenges, either directly or indirectly. Challenges directly addressed are challenges (i), (iii), (iv) and (v). Political stability will not be addressed directly, but will be an indirect result of a successful outcome of our ambitions.

1.4.2 The most important factors that the area needs to address

Important factors that may affect the outcome of the ambitions and that need to be addressed are: (i) consumer awareness and mobilization for a change in consumption patterns, (ii) local government’s attitudes, ambitions and actions to educate and mobilize consumers, (iii) different organization’s willingness to engage in both vertical (from local to global) and horizontal (from one organization to another at a certain vertical level) cooperation, (iv) development of energy, water and nutrient efficient components and systems.

1.4.3 Important risks, challenges and possibilities for the area

As has been discussed in the consortium, there are no real inherent risks in the area and the programme. This is since the area covers such a fundamental human need as food production and supply. It is rather so that if a number of challenges and factors develop in an undesired direction (e.g. poorer economic development, increased political conflicts, increased environmental impact), the value of the programme will only increase from both a national Swedish perspective and from an international.

The challenges are severe. They reach from challenging at least parts of the current financially driven globalisation with all its advantages for certain groups, via challenges of establishing agreed upon systems for a broader quality concept for food (including considering food security, food quality, food environmental performance and food ethics), to meeting Swedish challenges of high employee salaries and high standards for food production.

We consider the possibilities for the area to be very great, not to say enormous. The background strategic innovation agenda told us that this area has fantastic prospects. It could renew an important part of food production and supply, make food production less vulnerable to climate and weather impact, use far less scarce land than open-field production and not the least take care of important rest streams of heat and organic material from industry and urban areas.

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1.5 Most important needs to fulfil within the strategic innovation area

1.5.1 The most important challenges and measures to meet them

Today, we have substantial knowledge and experience about land based production systems. These systems, however, were developed at a time when there was no or little general awareness of e.g. (i) physical resource limitations (land, energy, materials), (ii) the potential large scale environmental impacts of an escalating global economy, and (iii) the increasing demands for global equity following the spreading of modern information and communication technology. Today such challenges are generally agreed upon – manifested in plentiful national ambitions to reach a sustainable development – thus the situation is different. Now, increased support and collaboration between different actors are needed in order to further develop more efficient and socially accepted goods and service supply systems.

In our strategic innovation agenda, we have identified four major challenges/needs: (i) food security, (ii) food quality, (iii) environmental performance of food supply and (iv) a high ethical level in production and animal breeding. These needs can be broken down to a number of more detailed needs connected to aquaculture and horticulture in land based intense cultivation e.g. (i) identification of suitable species of fish and plants for cultivation, (ii) fish reproduction and fish breeding, (iii) plant reproduction and cultivation, (iv) energy efficiency of cultivation systems, (v) recirculation of rest products from urban areas and industries, (vi) technical performance improvements of equipment, (vii) development of new biological and technical systems, and (viii) integration of systems into circular systems.

The measures to meet the key needs must be centred around improving the food system performance with respect to the four pillars of our agenda vision. The overarching challenge in achieving this is extremely complex and requires the establishment of a positive cooperation between a multitude of actors and stakeholders. Such development is extremely challenging to establish and requires public intervention in order to get initiated. This is since it involves time-consuming and often painstaking integration of opinions, cultures and deviating interests. Therefore it is very unlikely to happen without public intervention. Another important aspect is that it is often fostered by creating a neutral arena for cooperation. This means establishing a platform where the system success is the overarching goal and will lead to improved gains for the different partners in the cooperation.

The strength of the proposed programme in meeting the needs lies on the fact that: (i) It gathers a large number of industrial enterprises, consultants and academic institutions with both a specialized knowledge of necessary systems components as well as complex technical systems. (ii) None of the identified partners can meet more than a small fraction of the challenges identified and implement the solutions proposed. (iii) It is the system of partners and stakeholders identified who has the potential to reach success.

1.5.2 The barriers against development and the system weaknesses

The most important barriers against a development in the desired direction of the agenda are the following: (i) Difficulties of implementing an agenda that challenges existing values, norms and practices of the global food system, where food may be produced far away from consumers in the western world and in countries with low salaries and far weaker regulations and poorer practices than in e.g. Sweden, (ii) domestic inertia in addressing the challenges that are described in the agenda and (iii) difficulties in getting agreement between different actors on which is the way to go.

The consortium behind the agenda and this programme has identified the consumers and consumer oriented organisations as the most important problem owner groups. A lack of mobilization among consumers and of consumer oriented groups such as local governments and NGOs is therefore regarded as a main weakness of the whole food system and of food supply to urban areas. A very special actor group is therefore local governments, represented by municipalities and province governments. Here, we have an actor group that may influence food supply to schools, to hospitals and to homes for the elderly.
No single actor has so far demonstrated the strength to address these barriers to a modified food production and supply in an adequate way. Many promising initiatives have been taken, such as local initiatives to supply eco-labelled food besides the big actors, start-up of local urban agriculture groups and NGOs starting public education and information programs. Government spending will be necessary to further strengthen such initiatives to increase consumer awareness and mobilize local governments.

1.5.3 Which goals demand financing from the SIP programme and which goals will be handled and financed by other means

The answer is simply, we do not know yet. As pointed out above, the traditional way to handle the described challenges is by a reductionism, handling only small parts of the problem at the time. Not too surprisingly, and in spite all good intentions, like the famous example of a group of people trying to describe an elephant in the dark by given an area each to feel, it is not successful. It is too complex for a single group to handle and must be approached by combined interdisciplinary and triple helix efforts, and with economic support by the public. This until individual areas of business are discerned, where industry will take over in part. We therefore estimate an initial three year time span before this question may be adequately answered. Having said this, we already see a major difference in time span for this process where the giant shrimp farm of Bjuv, Skåne is a good example in that even before the test bed at Uppsala was completed, industry had already acquired a building permit for a commercial production site. We expect many more examples like this proving that development of industry, as soon as the ideas have taken hold, is much faster than any theoretical prediction.

References:
CGIAR (2011) A Strategy and Results Framework for the CGIAR, For submission to the CGIAR Funders Forum, February 20, 2011, <library.cgiar.org/bitstream/handle/10947/2608/Strategy_and_Results_Framework.pdf?sequence=4>

2 The strategic innovation programme (SIP)

2.1 Goals of the strategic innovation programme

2.1.1 Programme Vision

The programme vision is to make a significant contribution to a viable sustainable food supply to urban areas. Important challenges to future food supply are (i) food security, (ii) food quality and traceability (iii) a high environmental performance of food production and supply and (iv) a high ethic level of food production including animal welfare. To meet all these challenges in a growing world economy, it will be necessary to also increase and improve recovery and recirculation of organic material and nutrients. The proposed programme will focus on combining knowledge, technologies and approaches within the food supply system with special attention paid to three main sub-areas: (i) aquaculture in closed systems, (ii) horticultural production systems and (iii) feed from rest product streams. The result will be eco-cycle oriented, industrialized systems established in proximity to urban areas and using very small land surface area. The visionary end result is sub-systems integrated into closed loop systems using aquaculture, horticulture and rest products from industry and urban areas in order to contribute to a circular economy.

2.1.2 Programme goals

The following goals have been established for the SIP:

- Develop a new Swedish industry and create a platform for outstanding innovation.
- Innovate Swedish industrial solutions and areas of business in the food supply area.
Develop new sustainable food production chains based on closed loop systems with increased use of residuals to minimize costs and environmental impact.

Contribute solutions to some of our great challenges in society related to food production and supply.

### 2.1.3 Preliminary part time goals and planned evolution of the programme

The proposed SIP, the four pillars on which it is based, the five sub-goals for the first three year period, integration of the five sub-goals into two major goals after 6 years, the integration of solutions into urban-industry related food production and supply after 9 years and finally the full realisation of the vision in the future is illustrated in Figure 2.

### 2.1.4 Programme divided into three sub-areas that will be integrated

The proposed programme has been divided into three main sub-areas as shown in Figure 3:

- Aquaculture in closed systems;
- Horticultural production systems;
- Feed from rest product streams.

The three areas are shortly described in Figure 3. The planned programme is expected to last for approx. 10 years but have a much longer (illustrated as n in Figure 2) impact at the societal level.

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![Sustainable Food Supply to Urban Areas in a Globalized World](image)

**Figure 2.** Planned time development for the proposed programme over 3 consecutive 3-year periods.
Figure 3. The three sub-areas in the SIP. A strong central ambition in the programme is to integrate the three sub-areas into well-functioning production in eco-cycles as indicated in the centre of the figure.

Table 1 Goals of the strategic programme

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<td>Create improved knowledge and competence throughout the full value chain</td>
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<td>Policies and strategies for a broader approach quality</td>
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2.1.5 Potential to contribute to a safe, environmental friendly and effective energy system
The programme has a general approach to make resource use more efficient and promote circular production systems. Here, guiding principles will be (i) a more efficient use of primary energy (electricity and fuels) as well as (ii) recovery and use of secondary energy (waste heat). A main specific contribution to a safe, environmentally friendly and effective energy system is however that proposed production chains to a great extent will use residual products and excess heat, e.g. from nearby industries or energy production plants. The design of new production chains will be based mainly on low temperature systems which will also add to the contribution towards a more cost effective, environmentally friendly and effective energy system. As a final step, organic rest products from proposed production lines can be used for production of biogas that can be used directly or being upgraded and used as a vehicle fuel.

2.1.6 Why does the programme contribute to the fulfilment of the five overarching effect goals

Global challenges: The programme addresses perhaps the most important of all human challenges; how do we feed a doubled urban population within 30-40 years without destroying important ecosystems and/or causing social unrest.

Supply, welfare, environmental and energy goals: The programme targets the bull’s eye of this overarching effect goal. Supply by targeting the global goal of food supply; welfare by aiming at establishing a new industry; environmental goals by proposing a new broader quality concept including among other aspects a life cycle approach to environmental performance standards.

Sustainable growth: This effect goal is reached by the fact that economic growth according to the overarching SIP vision will lower environmental impact of food supply.

Strengthened competitiveness: The fulfilment of the SIP’s innovation goals will create a new Swedish industry that potentially could be world-leading in industrialized, sustainable food production and supply for which there is a world-wide demand.

An attractive country to invest in: Future economic success must be based on sustainable solutions – solutions that incorporates economic, social and ecological aspects in a balanced way; this SIP could make Sweden a role model in urban-industry related food production and supply.

2.2 Expected results and effects

2.2.1 Expected overarching results
Related to our four main goals of the programme, we expect the following overarching results:

- A new Swedish industry is created;
- The programme has developed a number of successful industrial solutions in the food supply area;
- The programme has demonstrated the feasibility of an increased use of urban-industry related rest products to minimize costs and environmental impact in the food supply sector;
- The programme has contributed with solutions to some of our great challenges in society related to food production, supply and consumption.

2.2.2 Expected overarching effects
The expected overall effects of the programme are the following:

- A new viable option for food primary production enters into operation in Sweden and later elsewhere;
- Sweden’s degree of self-support in food supply will become higher;
- Locally produced food will increase food quality and food traceability;
- Swedish consultants and equipment suppliers will get an increased demand for their services and products;
• Eco-cycle based solutions will gain entrance into the food production and supply area;
• Sweden’s reputation as a role model in sustainable development will be strengthened.

2.2.3 Compilation of expected results and effects during a first three year period
The broad scope of the innovation area and the programme, the number of (potential) actors to be involved and the complexity involved means that we have only been able to make a more detailed compilation of expected results and effects during a first three year period. Table “Expected effects and Result is presented in Table 2 enclosed as separate appendix (Appendix 2) as instructed.

2.3 Renewal of the innovation area by the SIO-programme
We expect to renew the innovation area by actively working with the following:
• Create a neutral national cooperation platform where industrial, consultancy and academic knowledge, competence and interests can meet and interact mutually and with consumer oriented stakeholders such as municipalities and NGOs in the field of urban oriented sustainable food supply.
• Combine existing technical and biological competence within Swedish industry, represented by energy, food and agriculture industries, and focus on new eco-cycle oriented and industrially oriented food production with a high technical content.
• Combine biological and technical academic knowledge and competence, in a first step represented by the Royal Institute of Technology in Stockholm (KTH) and the Swedish University of Agricultural Science in Uppsala and Alnarp (SLU).
• Use to an increasing extent organic and nutrient rich rest products from urban areas and industry as raw material for biological and technical transformation to food and feed components.
• Use existing and new knowledge and competence to create new eco-cycle oriented systems approaches to food and feed production and bring this to full scale application.

3 Actors

3.1 Key actors for the initiation of the programme
Six organizations have played a key role in the development and formulation of the strategic agenda. They continue to support the agenda and the implementation of the strategic innovation programme. The six organisations founding the programme are all strong stakeholders in the innovation area. They represent academia, the business community and public authorities. They have all a strong commitment to the management and will assure the implementation of actions in the program.

The six key actors are:

1. **Swedish University of Agricultural Sciences** is a university with comprehensive knowledge of the sustainable use of biological natural resources, as well as of the environmental and life sciences. The activities span from genes and molecules to biodiversity, animal health, bioenergy and food supply. Urban and regional planning, sustainable urban and rural development and global issues such as climate change are also on the agenda. To summarize, the work is about how to use biological natural resources from forests, soil and water without exhausting them, while preserving welfare for humans and animals. This is the fundamental principle that permeates the education, research and environmental monitoring and assessment at SLU. SLU is represented by Professor Anders Kiessling, Associate Professor Torbjörn Lundh, Head of the Department Linda Tufvesson and Head of the Department Margareta Emanuelson.

2. **KTH, Royal Institute of Technology in Stockholm** is the largest and oldest technical university in Sweden. No less than one third of Sweden’s technical research and engineering education capacity at university level is provided by KTH. Education and research spans from natural sciences to all branches of engineering and includes Architecture, Industrial Management and Urban Planning. The
university is internationally leading in areas such as information and communication technology, telecommunications and biotechnology. It has also a strong reputation in chemical engineering, mechanical engineering and planning sciences. The newly formed department of sustainable development, environmental science and engineering has a strong basis in systems thinking and Industrial Ecology. KTH has expressed an interest in devoting increased efforts to land and water based production. KTH is represented by Professor Björn Frostell and Docent Fredrik Gröndahl at the Division of Industrial Ecology, KTH.

3. **Swedish Surplus Energy Collaboration.** In 2012 a partnership agreement was signed between SLU, ESS AB, E.ON Sweden AB, Malmö municipality and the municipality of Oskarshamn. Several other stakeholders have since joined the collaboration. The collaboration spans over several areas as vegetable and fish production, creation of new healthy living environments for people and contributing to local and regional development. A focal point is to strengthen collaboration between academia and industry. Work is underway at 10 different locations in Sweden in 8 sub-programs, from Härnösand in the north to Malmö in the south. At each of these locations, municipalities, colleges, companies and stakeholder organizations work in cooperation. The overall goal of the SSE-C is to contribute to the construction of a new Swedish industry, based on modern greenhouse cultivation and contemporary land-based fish farming in industrial symbiosis. SSE-C is represented by program manager Håkan Sandin, SLU Alnarp.

4. **Ramboll Sweden AB.** Ramboll has offices in 350 countries and 12,500 employees worldwide, with a strong presence in the north. In Sweden, Ramboll has 1500 employees. The Ramboll employees are constructors of modern society, using engineering, design and management consulting. Ramboll has specific knowhow in bioenergy, waste solutions, energy transfer and energy storage, all with special relevance to the SIP. Ramboll is working with the community in every sense, with a focus on sustainable solutions. Ramboll is represented by senior consultant Gunnar Nordberg.

5. **Ecoloop** is a small consultancy firm working with different services related to energy, water and materials in the built environment. Ecoloop has been working for more than 10 years on strategic consultancy and sustainable development in the built environment and its supply systems bringing research to best practice. Its strategy is to contribute to development by providing services from initiation / evaluation, validation / introduction to the realization / institutionalization to create both services and learning. Their services in this relate to: Investigation and counselling, development and demonstration and transfer of knowledge. Ecoloop is represented by PhD Anna Norström.

6. **NÄRFISK.** The initiative NÄRFISK originates from a network entitled Sustainable fish supply in Stockholm County, a network that was initiated with support from the County Council's environmental grants in Stockholm, where three sub-projects were carried out during the period 2008 to 2012. The network began as a partnership between the company Ecoloop and the Royal Institute of Technology, with Ecoloop as project owner and KTH as project manager. Over the last 2 years NÄRFISK has implemented a large test bed project (approx. 10 million SEK) at Ljusterö in the Stockholm archipelago and received a planning grant from Vinnova for a second large project, aiming at building a full scale RAS system. This project is implemented during the period June 2014 to March 2015 and aims to submit an application for continued work in August 2015.

Gradually, the initiative has developed into a base for the interaction between companies and academia in the test bed RAS Ljusterö, increased cooperation between SLU and KTH and market oriented work where municipalities as primary representatives of the real problem owners - consumers - play an increasingly important role.

3.2 **Additional key actors in the implementation of the programme**

The Federation of Swedish Farmers, LRF, – is an interest and business organisation for the green industry with approximately 170 000 individual members. Together, they represent some 90 000 enterprises, which makes LRF the largest organisation for small enterprises in Sweden. Almost all
cooperatives within Swedish agriculture and forestry are members. LRF, and its seven subsidiaries, promote development of the green industry and its farmers of agricultural and forest land, growers and entrepreneurs so that they can fulfil their vision of growth, profitability and power of attraction. LRF seeks to create the appropriate conditions for sustainable and competitive companies and to develop a favourable base for social life and enterprise in rural areas. LRF is not affiliated to any political party and is an independent organisation which finances its activities by membership fees, combined with returns on asset investments and business operations. LRF is represented by board member Bengt Persson, chairman of LRF’s research foundation and their section for horticulture.

**Swedish Findus AB** is a subsidiary of the international Findus Group and the largest food company in Sweden. Findus “frozen food” was introduced in Sweden in the 1940s and has since been the driving force in the development of frozen foods. Today, a driving force for Findus is to ensure that food is produced in a sustainable way. Findus has climate certified vegetables in the product range and a programme for sustainable fishing from sustainable stocks – Findus Fish for Life, which won the EU environmental award in 2010.

**Swedish cities and municipalities.** Malmö, Stockholm, Uppsala, Härnösand and Karlskamn have been involved in the shaping of the programme and contribute with a Letter of Intent, declaring interest in participation and identifying contact persons at senior manager level. Several other municipalities are participating in the networks SSE-C and NÄRFISK.

**Stockholm Consumer Cooperative Society (SCCS)** represents 750,000 consumers in the greater Stockholm area. SCCS is a strong stakeholder representing the interests of the consumers in matters as healthy food produced under high sustainability and ethics standards.

**Swedish Food Retailers Federation (SFRF)** is the sector association for all grocery stores in Sweden. Grocery stores are an important part of the whole food chain and SFRF promotes that the industry take an active and joint responsibility for competitive neutral issues. Food safety and high environmental and ethical standards are among prioritized issues for SFRF.

The above listed partners are all influential stakeholders and with their different interests they are a form of guarantee for a program with a holistic approach. They will, like the original founders, take an active responsibility for implementation of the programme. A number of other organisations have participated in the preparatory discussions and provided valuable input to the programme. A detailed list of industries and organisations actively expressing interest in the programme or sub-activities are listed in appendix 4, together with signed LOI letters.

### 3.3 Target groups for UrbanFood

UrbanFood addresses in the long term both the Swedish existing primary producers of fish, potatoes, fruit and vegetables, the food industry processing these raw materials, distributors and retailers of food and food products and not the least consumers and consumer representatives such as municipalities and NGOs. In the start-up phase, there is perhaps a somewhat stronger focus on the production side of the production and consumption system. In full implementation, there will be a strong focus on the consumer and market aspects of sustainable consumption as part of a more efficient production/consumption system (cf. Figure 2). One of the innovative aspects of our SIP is that it covers the whole value chain from the primary producer to the consumer and aims at improving the food system efficiency along the whole value chain. Here, new entrepreneurs represent a potential target group at one end of the value chain. Their businesses can grow with the help of the proposed programme and improved market functioning. At the other end of the value chain, municipalities are a very important group of actors, because they represent powerful demand shapers and consumer representatives. As an example, in Sweden they have responsibility for schools and for elderly care and in this position can raise demands on food quality. The municipalities participating in this proposal have demonstrated that they are already at this stage dedicated and very keen to increase the supply of healthy and sustainable food.
3.4 The need for new stakeholders and financiers

There is a great opportunity to broaden the constellation of actors during the life span of the programme. We can offer municipalities in Sweden a very interesting development opportunity that will increase employment in new companies based on existing and upcoming innovations. All municipalities with access to excess heat have the possibility to produce local food, no matter where they are situated in Sweden, while becoming more environmentally friendly and providing new work opportunities.

If we take advantage of all the creative forces - from small-scale production of food to large scale initiatives and to the great cooking interest that exists in our country - we will be able to deliver many interesting products on the Swedish market and on a world market. To achieve this, academia, authorities (municipalities, regions, state administration and government), stakeholder organizations (e.g. producer and consumer organizations), Swedish industry (steel mills, paper mills, computer companies, and others), producers of primary food, financiers and consultants need to get involved.

Important future potential financers of this development are (i) those who have already been involved in this proposal, (ii) other representatives of Swedish industry with rest product streams or low grade heat, (iii) trade organisations, (iv) real estate companies, (v) banks. New business and funding models need to be developed in implementing the programme and in order to foster the process.

3.5 How to ensure that all relevant stakeholders have an opportunity to influence the programme, take part of financing and contribute to the objectives of the programme during implementation?

One of the crucial factors for success of the programme, is how well it will be received by current actors in the innovation area. An openness to cooperate with relevant actors is therefore a necessity from the start. The management structure and the decision-making procedures of the programme will be created in such a way that participating organisations and key persons may change over time. The long life span of the programme makes it necessary to have a readiness for potential changes and include new interested stakeholders.

There will be possibilities for interested organisations to participate in a reference group and give input to the actions and overall development of the programme. Different levels of participation will be possible in order not to exclude organisations with limited resources. It will, of course, be possible to participate in single activities. Strict disclosure standards will be applied in order to secure that calls will be fair and open to all relevant stakeholders in the sector. The same goes for other activities arranged within the programme.

In appendix 3 (Tables), we have compiled information about companies and organisations that have stated their interest in a Letter of Intent (LoI). In the same appendix, the table is supplemented with a table showing the larger number of companies and organisations that have expressed a direct interest to be involved in the program or its sub-activities. The key actors have been asked to interact more closely during the writing of the SIP application and have been asked to provide a LoI (see Appendix 4). All actors will either be included in the programme board or in the reference group (see Table 4 in Appendix 3). This will have to be settled in the first provisional half-year of the programme. Several actors already participate in either of the two networks SSE-C or NÄRFISK, i.e. are familiar with important aspects of the programme.

In total, the key actors together with other actors that have expressed written interest in the programme or are participants in the two networks SSE-C and NÄRFISK comprise more than 100 persons in approx. 50 organisations. Nevertheless, the interim program management foresees a strong need for further mobilization of actors during the first three years of the programme. Examples of important such actors are municipalities, newly formed companies in the area, other Swedish universities and international actors.
4 Coordination of the SIP-programme

4.1 Organization and leadership

4.1.1 Working model
The proposed innovation programme has been developed through a very fruitful collaboration within the core team with its different co-partners. From the beginning in the work with the Strategic Innovation Agenda and now with the Strategic Innovation Programme, we have identified that there is a need for new and developed co-operation between different key actors to create a new arena for innovation. This new working model is essential when we should achieve a new research and development process to introduce new innovations to the market related to sustainable food production.

As a base for our organization, we will build up an entirely independent platform for cooperation between the key actors of the programme. As parts of this platform, SLU and KTH have established an agreement for co-operation related to research, development and education connected to sustainable food production. In addition, it is also essential that the innovation platform takes care of the interests, perspectives and knowledge from all our stakeholders.

We are fully aware of the challenges in establishing multidisciplinary Research, Innovation and Development (RID) systems. All five persons in the interim project management have extensive experience from RID work. We have therefore built up the proposed organization from our knowledge of interactive and participative processes and organizations. In Figure 4, we show the main stakeholders identified to be of importance for the SIP and how we would like to build up the principal organizations. In Figure 4, we have also identified other important SIA/SIP initiatives connected to Vinnova and that we regard as essential to connect in one way or the other to our SIP.

Figure 4. A ball diagram showing the core group of the SIP UrbanFood, the connection to key stakeholder groups and the connection to other relevant SIA/SIP initiatives.
4.1.2 Organization

For our proposed programme office, we have identified 3 different functions to secure an effective work and interaction with different actors. The established main functions will be the programme board, programme management and the programme office. Key persons that will be engaged with the establishment of the programme office and later within the work programme are listed in tables in Appendix 2.

The programme board will be the overarching decision level for the SIP, taking decisions, based on material and information prepared by the program management and other relevant information available. Here, the programme management will have the practical responsibility for drafting development strategies, programme calls, education initiatives, information campaigns and other targeted actions. In this work, the programme management will interact with and try to absorb the different perspectives from participating stakeholders. To secure a cross disciplinary and cross culture interaction between involved actors, the board will be established with a true Triple helix organization with representation from business, academia and local governments (municipalities). We propose that it will have 4 representatives from business, 3 representatives from municipalities, 2 representatives from academia and 1 representative each for food consumers and food retail organization. The final organization will be discussed with Vinnova before selection of specific members of the board and the programme office. So far, we only propose that either Bengt Persson, LRF or Henrik Nyberg, Findus Sverige AB will be chosen as president of the board. The other will serve as vice president. The rest of the board members will be selected in co-operation with Vinnova during the start-up period for the programme office.

The programme management will have the main responsibility for identification of potential new innovations, potential new projects and possible new collaborations to enable the realization of the programme goals. Besides this main responsibility, the programme management will work with identification of actions and activities to support the mobilization of existing and new actors, such as workshops and programme information and communication. The core group for the formulation of the proposed innovation programme have found a very creative and dynamic atmosphere for developing ideas related to possible innovation why we propose that this team, to start with forms the programme management. These persons also represent the key organizations from KTH, SLU, Ramböll and Ecoloop that developed the SIA and SIP for the programme. Within the organizations, there is a broad experience and knowledge related to organization of how research and development programs, establishment of test beds, conversation of innovation to commercial production and also on how an effective office can be developed, including all processes and communication skills needed to make the office successful.

The programme management will be a part of the programme office and will start up the needed processes to obtain an effective and well-functioning office. This office will be developed to handle the dialogue with Vinnova, implement plans and activities and also for providing needed external information and communication. We have attached CVs for the key persons (within board and office) that will take the responsibility for development of the new programme office from the start. A tentative organizational chart for the programme office during the start-up phase is presented in Figure 5.

We will also establish a reference group that, to start with, includes all participants from the organizations that already have declared an active interest for the actual programme. These organizations are listed in Appendix 4.
4.1.3 Work plan for reaching the objectives

During the start-up period of the programme (first 6 months), the proposed goals, activities and expected results and effects will be discussed, revised and decided in collaboration between the programme management, programme board and Vinnova/Formas/Swedish Energy Agency. When established, the goals, proposed activities and expected results and effects will be presented to stakeholders and discussed in a joint workshop to further anchor the programme among the participating actors. The final part of this process is a final adoption of the programme in the programme board and with Vinnova/Formas/Swedish Energy Agency.

A work plan will be the common document that will guide the activities within the programme office. Therefore, this work plan will be updated frequently, tentatively twice a year and will during the start-up period mainly consist of activities related to the communication and development of the processes for the operation of the programme office. As soon as other activities are decided, they will be added to the plan.

The work plan will thereafter be the working tool for the progress evaluation of decided activities. A written report will be presented to Vinnova every 6 months for progress evaluation including an evaluation of how the progress corresponds to the overall objectives.

The progress, results and effects will be discussed twice a year within a group with representation from the programme board, programme management and Vinnova to secure that there is an overall agreement of that the innovation programme is well oriented and related to the established overall objectives.

4.2 Project plan for the coordination of the SIP-programme

The programme management will plan and organize all activities within the Innovation Programme. The work plan is the document where all activities are defined and followed-up. The project plan describes the tools for
how the programme office will work and co-operate and communicate within the office, with stakeholders, Vinnova, the reference group and other concerned parties. The work will be organized through the following activities during the entire programme period (tentatively 3x3 years):

- Programme conference once a year;
- Meeting within the reference group twice a year (whereof one meeting is combined with the programme conference);
- Board meetings 4 times a year;
- Programme management meetings twice a month;
- Program co-ordination meeting once a week;
- Establishment of a home page for both an open and internal dialogue;
- An information folder presented on the home page and through e-mail 3 times a year.

4.3 Budget for coordination of the SIP-programme

4.3.1 Budget for the start-up phase

The project management and the programme office will formalize its work and start operation during the startup phase. This will include all processes needed for the establishment of an effective office. To assure the effectiveness of the programme office, we have selected Anna Norström and Anna Zingmark to be responsible for this activity. This is (i) since Anna Norström has been a key person in the elaboration of the SIA and the SIP and (ii) Anna Zingmark has well-documented competence related to innovation and work with Vinnova.

During the 6 month startup phase, there will be an intense interaction between the interim programme management, the interim office, Vinnova and the interim board president and vice president. All these activities will be organized by the interim programme management. The interim programme management will select suitable persons for the long term administration of the programme and present a proposed final organizational chart for the programme office after the first 6 months. During this period, there will also be close contacts with the reference group to define possible participation during the overall programme period.

The costs for project management during the startup phase will predominantly consist of wages for representatives for SLU, KTH, Ecoloop and Ramböll and programme office coordinators from Ecoloop and Ramböll. Costs for offices and conference rooms will be covered by the office coordinators free of charge.

Members of the board will participate unpaid, but with travel costs reimbursed. Members of the board and project management are located in various parts of the country. Travel costs will therefore be substantial. Other types of costs will be related to external services.

Workshops and seminars will be organised. External costs will occur for the creation of the webpage and for information and communication measures.

The total budget for the startup phase is 2 000 000 SEK.

4.2.2 Budget for operating the SIP-programme

The proposed management structure established in the initial phase is supposed to subsist under the implementation of the program. A more detailed plan for the further implementation of the program will be developed in close cooperation of concerned authority.

Wages for the project management and coordination of the program will be the major source of expenses during the under the implementation phase as under the initiation.

Board meetings will be held on regular basis and the different activities will be implemented according to plan developed under the start-up phase.
5 Actions and activities in the SIP programme

5.1 Existing actions and activities to be used within the SIP-programme

Figure 6 illustrates connections between the proposed SIP and other on-going actions and activities of relevance for the SIP. The SIP has both own on-going projects in the networks SSE-C and NÄRFISK and good connections to other Vinnova UDI projects that would like to join UrbanFood. Besides this, we have identified five on-going SIA/SIP initiatives that are of important relevance for the future development of Urban Food. Here, the interim programme management has initiated a discussion with the Food for Health SIP. This discussion will continue during the start-up phase of the SIP and mutual possibilities for cooperation will sought. There is one on-going initiative that does not show up in Figure 6 and that is Sustainable Smart Cities initiative. Here contacts will have to be established during the start-up phase.

![Diagram](image.png)

5.2 Describe in detail each action/activity financed by the programme

5.2.1 Action/activity 1: Initial studies during the startup phase

a) Description – The proposed strategic programme aims to develop a new Swedish industry. During the process of writing the programme proposal, it has become clear that the description of the whole innovation area as well as the proposed programme is still a work in progress. Although more defined images and figures have been proposed and developed through interaction and dialogue with other actors, there are a couple of activities that should be part of the startup phase in order to provide a stronger foundation for the development of the detailed programme plan for the coming three years. Examples include:

- Compilation of an image of the full value chain where critical aspects, challenges and actors are identified.
- An inventory of critical aspects and challenges within the four pillars of the vision.

b) Expected results and effects – These additional background documents and images will serve as a common ground for deeper discussion of the SIP proposal and provide a base for prioritizing actions and activities during the programme.
c) Time plan and budget – Activities that will be carried out by the programme management team during the first months of the startup phase.

d) Targeted groups – internal and external communication for actors already within the programme as well as any other interested in this developing area.

e) Communication and knowledge transfer – should be presented in some form on the future homepage of the programme.

5.2.2 Action/activity 2: Open calls for research and development projects

a) Description – Within the three different sub-areas: (i) Aquaculture in closed systems, (ii) horticultural production and (iii) feed from rest product streams, as well as for the integration of systems, several research topics and needs for development activities and innovations have already been identified. These are given in short in Table 5 in Appendix 2 in order to present some of the ideas, challenges and possibilities for development and innovation that has emerged during preparatory discussions and workshops as part of the programme proposal process. These calls aim to support initiatives that seek answers that are in line with the goals of the programme and with emphasis on the four pillars of the vision. The funding provided by the programme will by no means cover all these topics.

b) Expected results and effects – the research and development projects will result in new innovative solutions, new knowledge and deeper understanding of the systems and system components, and provide stepping stones towards the goal of establishing a new line of production systems for food supply to urban areas.

c) Time plan and budget – the aim is to manage one open call annually. The research and development projects will be the significantly most important activities in the total budget for the programme. The degree of co-funding will differ between projects but cooperation with other initiatives and joint projects between academia, industry and authorities will be highly encouraged.

d) Targeted groups – all actors interested in this emerging field.

e) Communication and knowledge transfer – the programme webpage will serve as a platform for results as well as the respective communication channels provided by involved partners. Results and new knowledge will feed back into on-going and future activities, influence education material, and be presented during network activities. Results will also be included in traditional research communication, by industry implementation, by demonstration and study visits and publication in trade journals or equivalent.

5.2.3 Action/activity 3: Strategic projects, specific investigations and studies

a) Description – In addition to the broader and complex questions that will be targeted through the open calls, several defined topics and questions that need to be addressed have also already been identified. In these cases, a more optimal solution might be a joint assignment between experts or a shorter study performed as a thesis work or part of a PhD-project. Depending on the setup, the programme will co-finance a study together with other partners or delegate the assignment to the most suitable actor. It is foreseen that questions will arise throughout the programme period that will require this kind of support. Such topics can be proposed by actors in the programme, the project management, the programme board or other actors. The programme management will be the governing body for initiating and stimulating such actions.

a) Expected results and effects – identified thresholds will be investigated and solutions proposed or provided in order to minimise barriers or to acquire a deeper knowledge of specific questions. The results might be short-term, but the effect of using this new knowledge will be shown in the long-term perspective.

b) Time plan and budget – a part of the annual budget will be earmarked for these activities.

c) Targeted groups – preferably actors who are already working in an adjacent area, where the financing from the programme can be used as co-financing.

d) Communication and knowledge transfer – the programme webpage will serve as a platform for results as well as the respective communication channels provided by involved partners.
Results and new knowledge will be fed back into on-going and future activities, influence educational material and be presented during network activities.

5.2.4 **Action/activity 4: Test beds and demonstration units – create integration, enhance knowledge exchange and capacity building**

a) Description – There are several on-going and planned national initiatives that are working with parts of the food supply value chain as defined by this programme. Today, however, there is no joint platform where these initiatives can learn from each other. Development is happening but a catalyst is needed to further speed up the process. This action aims to create strong integration and enhance knowledge exchange between on-going and upcoming test beds and projects through open seminar series, study visits and travel support. The goal is to help structure and develop Swedish national skills and competence. The test beds/demonstration units should also be used for educational purposes to demonstrate systems functioning and attract more actors and work labour into this sector.

b) Expected results and effects – after the first three years the programme has created strong integration of at least 4-5 existing test beds and upcoming projects for partial solutions to the challenge. In a long-term perspective the programme has contributed to the education and capacity building of individuals and organisations that will provide new working opportunities within this sector.

c) Time plan and budget – on-going activities throughout the whole programme period. The programme will finance administration and joint activities, participants will provide time and access to their facilities.

d) Targeted groups – actors working with or interested in the practical aspects of primary production and food supply.

e) Communication and knowledge transfer – distribution and if needed preparation of information and presentation material at physical meetings or provided on the webpage.

5.2.5 **Action/activity 5: Establishing an urban laboratory**

a) Description – The long-term goal of the programme is integrated food production systems where solutions from the three subareas will be used in different setups to provide food supply based on the four pillars of the vision. During the first three years of the programme, the following initial steps/activities will be carried out:

- Identify national and international research, innovation and development initiatives and establish contact with relevant stakeholders.
- Support development of biological and technical system components in physical test beds for partial solutions to the challenges through different activities, e.g. open calls.
- Support the establishment of a national production unit for integration of partial production systems into a circular solution through networking opportunities, financial support and knowledge exchange.
- Promote collaboration between industry, academia and government agencies in test bed activities.
- Together with interested stakeholders develop and present a plan and preliminary budget for the establishment of a pilot urban laboratory for urban-industry related food production and supply.

b) Expected results and effects – the main goals of this action are the mobilisation of actors and the creation of a platform for a joint effort towards the establishment of a pilot urban laboratory. After the first three years of the programme, a plan for this is produced, presented and agreed upon.

c) Time plan and budget – today test beds can be financed through e.g. Vinnova projects and other research agencies. Financing from this action aims to ensure that the quality aspects as defined by the programme are prioritized and developed, and will primarily be used as co-financing to projects that are already financed to a major extent by other means. A part of the budget is earmarked for the development of the plan for the urban laboratory.
d) Targeted groups – academic research, industry and in part also regions and governmental decision makers will benefit from this action.

e) Communication and knowledge transfer – results will be included in traditional research communication, by industry implementation, by demonstration and study visits and publication in trade journals or equivalent.

5.2.6 **Action/activity 6: Communication**

a) Description – Major tasks for the programme office will include mobilising the different stakeholders and information and dialogue within the programme network as well as external communication with consumers, authorities and other relevant national and international initiatives. Since this is to a great extent a new area of development, the support of already existing networks and an established industry are largely not provided, nor is the legal framework present. The interest for a more sustainable individual lifestyle is, however, growing rapidly among consumers and within organisations, authorities, and industries. A communication plan will be developed including strategies for extensive communication through traditional and modern social media, as well as the use of other communication methods.

b) Expected results and effects – a success factor for this programme is consumer acceptance, and information is the key to make sure that customers accept the new products and new means of production. The long-term effect of a successful programme will be a generally accepted broader quality concept for food (including considering food security, food quality, food environmental performance and food ethics), and a significant change in consumption patterns at the end of the programme (10 years).

c) Time plan and budget – this is difficult to discern as a large part of involvement is based on self-interest and the largest cost will be the time and travel of the receivers. The budget will therefore be a part of the program office, be included in project budgets and possibly also be included in special targeted activities decided as the programme develops. The communication will in part be the direct responsibility of the program office and is therefore in part described also in chapter 4. A large part of the work may be shared with organisations as LRF, aquaculture associations, NGOs, universities, and authorities such as the Swedish Board of Agriculture, who also in their respective programmes target communication.

d) Targeted groups – Already during the first three years, focus will be on consumer mobilization and mobilization of consumer oriented actors, such as municipalities. In continuing work, consumption aspects will be increasingly dealt with as an improved mobilization of consumers has been gained.

e) Communication and knowledge transfer – is the main purpose of this activity.

5.2.7 **Action/activity 7: Networking activities**

a) Description – This programme is based on two existing well-established networks. During the formation of the programme proposal, several other stakeholders have also expressed their interest and support. The aims of this action are to:

- Provide a platform for stakeholders with interest and engagement in the food production and supply area.
- Identify and establish contact with existing national and international research, innovation and development initiatives from all parts of the value chain.
- Support a consensus oriented and inclusive discussion on anchoring the world views, identified challenges and the proposed preliminary solution oriented activities.

b) Expected results and effects – increased synergies between projects and disciplines. We also expect to acquire a by all perceived transparent, open and inclusive structure given acceptance to be maintained over the whole programme period

c) Time plan and budget – activities will span over the whole programme period, and display different phases, i.e. start-up, mobilisation, stabilisation and consolidation, and then operation.
d) Targeted groups – academic research, industry and in part also regions and governmental decision makers who will benefit from this action.

e) Communication and knowledge transfer – is in part described under chapter 4, but will include meetings in workshops, program meetings, participation in other meeting e.g. conferences, annual meetings of farmers’ organisations etc. It will also include internet based solutions such as the programme homepage and social media.

5.2.8 Action/activity 8: Education

f) Description – the innovation area is very large and the proposed programme intends to cover parts of this area. However, many of the building blocks within this programme, for example the development of new technical, biological and integrated systems and their system components, innovations, progress and contributions within the broader quality concept for food (i.e. food security, food quality, food environmental performance and food ethics), marketing strategies and many more are applicable for other areas as well as for all levels of education ranging from primary school to academia, and from consumers to practitioners and decision makers. Examples of activities that will commence during the first phase of the programme are:

- Develop education and training programmes for students and operators in cooperation with test bed and demonstration unit actors.
- Create meeting places for communication and dissemination of knowledge and competence, through e.g. seminars, conferences and training sessions, traditional and interactive distance education.
- Arrange a joint PhD school between SLU and KTH

a) Expected results and effects – in the short-term perspective, educational activities will primarily result in an increased competence level for the actors involved in the programme. However, the long-term effects include increased competence level at all stages, increased interest to apply to higher education with relevance for the area etc. More expected results are given in Table 2 in appendix 3. The number of students at different stages and the number of new courses at different stages as well as how many schools that has adopted the subject area are all indicators of the success of this action at different time periods.

b) Time plan and budget – development of new curricula takes time, hence, this work needs to be initiated immediately and will be on-going throughout the whole programme period. Focus during the first phase will probably be in the form of stimulation activities but as the programme progresses this will shift more and more towards support of knowledge transfer and the development of educational packages. The main driving force should be the different universities and schools, who will ensure the pedagogic quality of the material, as well as provide co-funding.

c) Targeted groups – actors responsible for education and developing curricula at all levels. Strong synergies are expected with all universities and other education organisations, who also are the major receivers.

d) Communication and knowledge transfer – is central to this activity and is in principle similar to the network and communication activities.

5.3 Budget for actions and activities

The budget numbers presented below, have been thoroughly discussed in the interim project management group, but have not been anchored in the broader actor group for the SIP. They should therefore at this point be regarded as a first estimate of budgets and of the relative sizes of partial budgets. We expect the budget to be refined during the first six month start-up period.

The total budget of the programme is estimated to 2 MSEK 2015. The entire budget for 2015 will be spent on coordination and management. The costs will rise to 78 MSEK 2016 and 103 MSEK/year 2017 – 2019. Included in those figures are coordination costs, estimated to 3 MSEK/year. The actual implementation of the program will start, and the first call will be opened, in the beginning of 2016.
Ecoloop is appointed by the SLU to handle the day to day coordination of the project. The coordination costs are therefore in the electronic form dedicated to Ecoloop and not the formal coordinator of the program. There costs for implementation of the programme will be spent by a large number of stakeholders in the innovation area. These stakeholders cannot be stated at this moment. It is therefore just of practical matters that implementation costs are stated as cost related to the coordinator in the electronic form.

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6 Weaknesses and threats for the SIP-programme

6.1 General

According to our established agenda the main overarching weaknesses (barriers to a successful outcome) of the SIP are: (i) the difficulties in challenging the on-going economic development, where primary production in high income countries with strict laws and regulations move to low income countries with less stringent regulations, (ii) domestic Swedish inertia in wanting/daring/mobilizing efforts to address the overarching challenges identified in our agenda and (iii) difficulties in reaching a mutual understanding and joint ambition between actors on where to go. The following is a more detailed discussion of the three weaknesses.

6.2 The identified weaknesses

6.2.1 The agenda challenges the overarching economic development

Our analysis in the Strategic Innovation Agenda (SIA) points doubtlessly on the fact that very strong economic interests have shaped the rapid globalization of food supply during the last few decades. Simplified, possibilities to large and rapid profits facilitated by access to low salary labour and weak legislation, cheap (fossil) energy and cheap chemicals, have made a rapid increase in global food
supply possible. In the short, this has resulted in very substantial progress in the form of both access to food, variety of food and low food prices. Sorry to say, many signals point at the fact that this development is not sustainable in the long term. With Sweden being a small country in the global economy there are large risks involved in radically challenging the existing situation on the world market. Swedish efforts to partially shape new approaches to urban food supply must therefore be paralleled with political efforts to establish international rules, regulation and standards for food supply and food quality in a very broad sense. A great initial challenge in this respect will be the relatively high income level in Sweden. Here, we see no other way than being in the frontline of improving overall efficiency in production, processing and distribution of food and in innovating new eco-cycle based routes to food supply.

6.2.2 Domestic inertia in addressing the identified challenges
The changes in urban food supply that the SIA have identified as desirable and necessary are expected to initiate debate in many instances. As an example, Sweden has had an important meat production during many years with a high standard of environmental performance, chemicals use and animal ethics. This in parallel with an increasing meat import in recent years has resulted in an increasing meat consumption that currently is almost 90 kg per person and year. At the same time, systems science has identified meat consumption as a highly contaminating and highly resource intense. Thus strong signals are at hand that consumers in high income countries need to lower their meat intake. Here aquaculture may offer great possibilities to a less resource intense protein intake and it is in our opinion logical that a substantial part of protein consumption is moved from red meat to white meat and especially fish meat. We are, however, fully aware of that such a transition will not occur by itself and will need both considerable time and efforts.

Another example – from Swedish aquaculture – points in the same direction. The main part of Swedish aquaculture is performed as cage aquaculture, which has a low resource efficiency in comparison to closed systems. Here, the Swedish aquaculture industry so far has shown little interest in moving towards more expensive but resource efficient closed systems. Also here, we foresee that improved dialogues and time will be required in order to reach a better consensus as to which way to go. Different aspects will have to be studied, valued, discussed and new solutions will have to be innovated.

6.2.3 Difficulties in reaching a mutual understanding and joint ambition
This SIP attempts to address future urban food supply from a sustainability perspective, addressing economic, ecological and social sustainability. This means an extremely broad ambition, especially since the innovation area in itself is so complex by definition. Here, it is important to realize the need for a mental shift among customers, authorities, scientists and engineers in order to see the need for and accept and purchase new products. Scientists and engineers need to refocus their research, innovation and development efforts and authorities need to adapt current regulations to new demands. It is important to see the new demands as possibilities and not as threats and as a process that will need at least 10 years to reach its full potential.

The new approaches also constitute a challenge to the commercial market forces involved in the current modes of food production and supply. Many scientists, engineers, economists and businessmen have devoted great efforts in creating the current food production and supply system. Scepticism among these individuals towards a partly altered food production and supply is natural. However, we believe this partial reorientation is necessary to meet future food supply challenges and mean that it is based on verified scientific knowledge about future possibilities and challenges.

6.2.4 Weaknesses identified in the final consultation with actors
In a final consultation with all interested actors behind this SIP, we were able to identify the following remaining weaknesses. There is a need to: (i) Include more actors from the consumption side (e.g. restaurants, chefs, NGOs); (ii) Get a stronger representation from social sciences (e.g. economic sciences); (iii) Include actors from the planning side (urban planning, green area planning).
6.3 Threats

The main threat to the programme lies in the novelty of the innovation area, demanding a paradigm shift in (i) thinking about food production and supply, (ii) practical approaches to how food production may be linked to rest product utilization and (iii) how eco-cycles can be implemented in practice. Here, the programme addresses both the overarching challenge of future food supply as well as other challenges discussed in chapter 2.

We regard the approach taken in this SIP as a radical innovation of future urban food supply and as such in many ways difficult to anchor in groups and organisations involved in present food production and supply. There is thus a threat that actors with interest in the current food production and supply are slow in joining the programme. Therefore it is very promising to see that several important Swedish actors such as LRF (Federation of Swedish Farmers), Findus Sweden AB and many municipalities are actively supporting the SIP.

The interim programme management of the SIP foresees a management threat in the form of potential conflicts of interest when the actual programme is implemented. This is since the actors initiating the SIP represent very different interests from the business community, the academic world, municipalities and consumer interests. These different cultures often with highly different agendas, have come together in this application with the aim to create an as strong and broad partnership as possible. However, when the actual programme work starts, it is highly probable that it will become problematic to meet all differing expectations from different stakeholders. This potential threat will have to be dealt with already from the beginning of the programme work and the interim management is very devoted to do so.

Besides these overarching threats to the programme, we foresee some more detailed threats with difficulties in realizing the ambitions of the SIP. Two examples of these threats are:

- In order to realize the SIP research, innovation and development parts, a number of test beds will be required. Only a few of them exist today and more will be needed.
- Existing laws and regulations are not adapted to a reorientation of food production and supply, especially not feed and fish production in closed systems. They need to be revised from a systems point of view (improved systems thinking as a basis for more up-to-date laws and regulations.

Such more detailed threats to the programme will slow down the implementation, but in our mind do not threaten the programme as such.