SEEDS and Azolla: Using the ‘wonder fern’ to lift rural farmers out of poverty

Ramachandran (2014)

by

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Introduction

Originally written for an essay for the author's studies on The One Plant MBA with the University of Exeter, this study was the result of my plan to choose a project which has potential to explore a Blue Ocean Strategy which could benefit people at the so-called 'Bottom of the Pyramid' (Prahalad, 2010)
At this point I would first like to clarify my critique of this concept.
As written the idea is set from the viewpoint of the Multi National Corporation (MNCs), and views the billion people below the poverty line as a potential market for exploitation. This does not sit comfortably with me. My approach in this strategy paper is to explore the potential for the poverty stricken rural farmer to become a part of the supply chain in potentially lucrative markets that may be prepared to utilise the Fair Trade mechanism. This would change the perspective of this market and enable these people to adapt to the modern world, learn business skills and become the FOUNDATION OF THE PYRAMID instead. This shift of power in the basic concept could be quite transformational, enabling communities to take control, educate their young people and build their local economy from the bottom up.
This would not mean that MNCs would be excluded, rather that they would have the opportunity to invest and achieve their Corporate Social Responsibility goals in a different way, which is more supportive and less exploitative.

Introducing Azolla

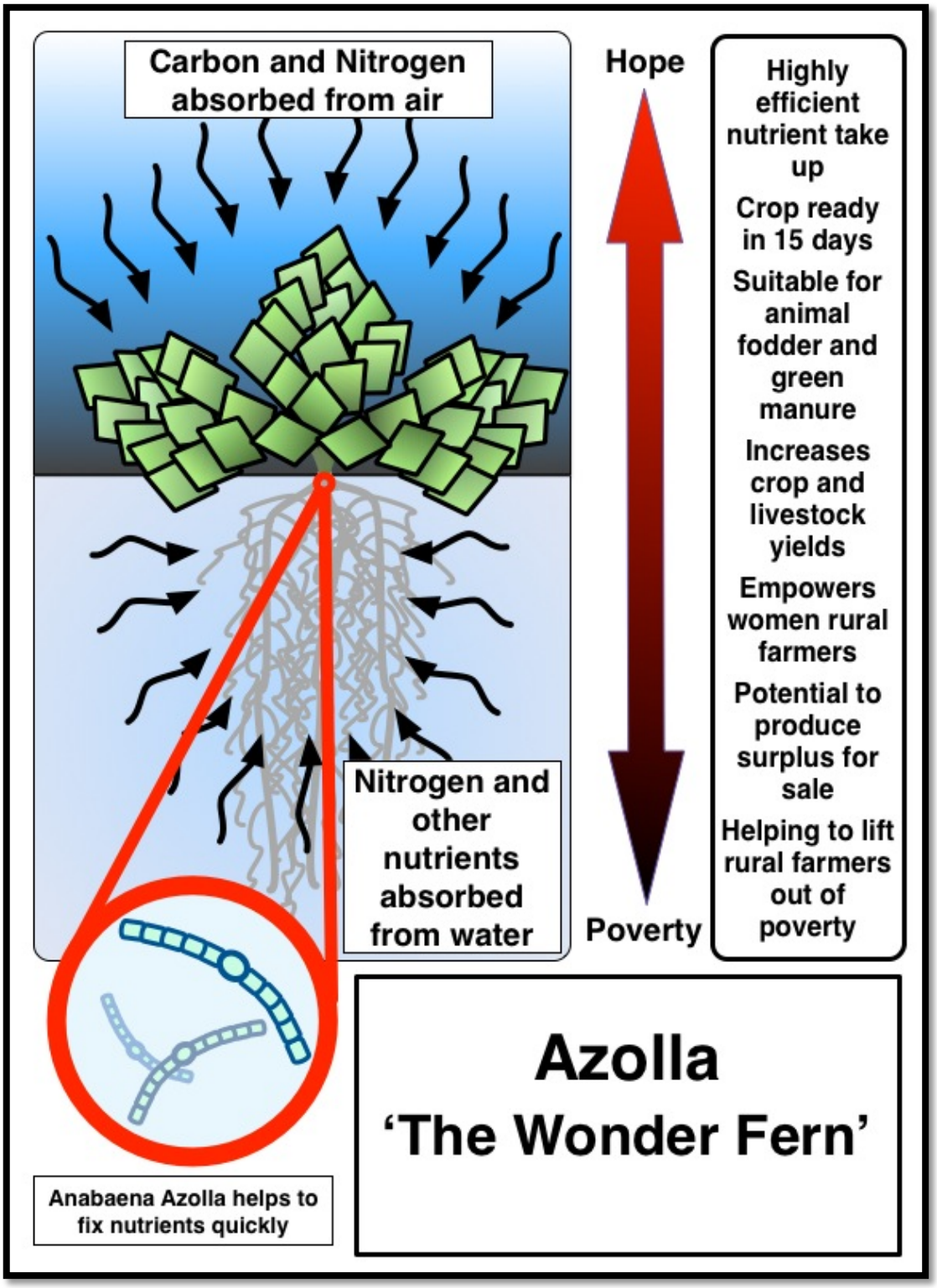
An infographic, which I have designed for the project to use for promotion purposes, is shown on the next page and introduces the aquatic fern, Azolla. This plant has several species, indigenous to different areas globally and is already widely used to manage the ecosystem within rice paddies. The plant is relatively easy to manage for production and the commodity currently in use is the education process in managing and utilising it effectively. This is the fundamental basis of the project as it stands currently. This will be discussed in more detail in the next section.

The project is being led by an organisation called the 'Socio-Economic and Education Development Society' or SEEDS. I have had several email exchanges with the project leader, A. Ramachandran, who has welcomed my input and will be utilising this paper to support the work he is currently doing, so my thanks go to him for his support in developing this paper.

Mr Ramachandran is working with the Tamil Nadu Agriculture University to explore the project's potential and is currently hosting a crowdfunding attempt for around €2500 to enable up to 50 women rural farmers to set up their first Azolla crops. This is hosted on the 1% Club, a website which enables small projects to source funds for specific programmes.

Initial discussions, are underway to ascertain to what extent could markets be created for this plant, which is widely recognised among botanists and anthropologists to have very high potential for contributing to the food chain. Accenture are supporting the project by funding a competition for students to propose strategies for entry to the markets identified in this paper, a change which has emerged during the period of my discussions with SEEDS and a very exciting development.

To understand the plant and its potential I have read widely and to ensure the learning is shared fully I have captured the full list in a Bibliography at the end of the paper, following the references section.



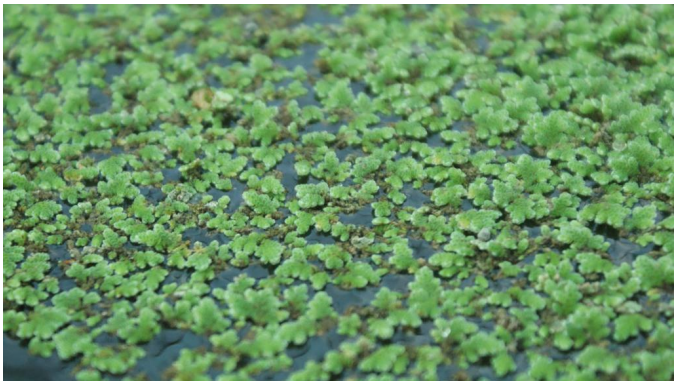
As the infographic shows, the plant utilises a symbiotic relationship with a cyanobacteria call Anabaena Azollae, which facilitates the highly efficient fixing of nutrients, particularly nitrogen, which increases the nutritional value of the plant significantly when compared to other food plants. (Hove and Lejeune

(2002), Shi and Hall (1988), Lumpkin and Plucknett (1980), Tung and Shen (1981))

There are studies that show that due to the digestion needs for the plant there is a limit to the intake level in some species, however, this does not diminish that there is a clear benefit in offsetting part of the nutritional needs of the animal with what is, effectively, a low cost dietary supplement. (Alalade and Iyayi (2006), Laterme et al (2009), Laterme et al (2010))

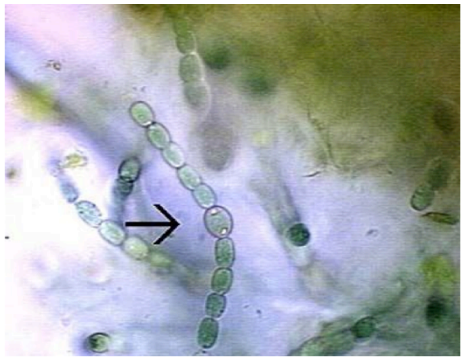
Azolla pinnata (Navie (no date))

Azolla filiculoides (Unnamed photographer (2013))



Azolla Microfila (Ramachandran, A. 2014)

Azolla roots showing feathery filaments, highly efficient for fixing of nutrients (kennedyh (2007))



Anabaena Azollae symbiont cyanobacteria (Fisher (2006))

The Project

The project itself has been established at a test farm to prove the concept, in the Tamil Nadu region of India. The 1% Club crowdfunding element of the project led to the development of the Accenture proposal, which will enable up to 20 students to investigate how realistic a business case for creating a market for the nutritional supplement industry would be. For the purposes of this paper I have understood where the project currently stands, suggested potential 'Blue Ocean' strategies for exploration and compiled my findings, along with potential limitations which will enable further study by the Accenture students. This is a very exciting development which takes my work from a theoretical viewpoint to the potential of a real impact.
Led by A Ramachandran of the Socio-Economic and Educational Development Society (SEEDS) which is a grass root NGO based in Tamilnadu, India since 1994 the 'Azolla Cultivation for organic agriculture and fodder to livestock' Project focus is on rural farmers, mainly women, in the Tamil Nadu region of India. The SEEDS foundation has numerous other projects aimed at poverty alleviation, empowerment of women and social development.

Poultry feeding on Azolla (Ramachandran (2014))

Female rural farmer with her cattle (Ramachandran (2014))

The project expects to be able to set up 50 rural farmers to utilise Azolla at a cost of €40 per woman. At this scale the intention is to produce sufficient material for animal fodder supplementation with any left over to be used as green manure. The requirements for this level of production are relatively small and after the first 15 days a continuous cycle of growth can be expected in this region. As with all agriculture, this may vary with seasonality but the

area is less variable than, for example, the UK and other more temperate regions, so more sustained periods of growth can reasonably be expected. With the ability to become self-sufficient with just a small area for production this opens up possibilities which will be considered in later sections of this paper.

The first stage of implementation of the system is to prepare a tank. This need only be a relatively shallow area and can be set up with manure as a feedstock for the plants, which can also contribute to disposal and management of this type of waste.

Water is added to the tank and the plant is introduced. Growth is rapid and the plants float freely on the surface of the water, so very little effort is required to gather the crop. From time to time the tank can be stirred to help to release nutrients from the detritus sediment at the bottom. This helps to reduce the risk of eutrophication, where the amount of nutrients in the water becomes too high. With good management the levels are maintained and nutrients are taken up by the fern and brought into the food chain.

Empty Azolla tank being prepared for inoculation (Ramachandran (2014))

Managing the Azolla Crop (Ramachandran (2014))

Harvesting Azolla (Ramachandran (2014))

Harvested Azolla (Ramachandran (2014))

After harvesting, which is scooping the plants from the water, the produce is rinsed in clean water to remove any residue or debris, particularly if manure has been the nutrient source. In some cases this will be fed directly to the livestock, in the photo on the previous page the chickens help themselves.

Rinsing in clean water (Ramachandran (2014)

Providing feed to goats (Ramachandran (2014))

For cattle the plant is mixed with rice husks and water and this mix is easily managed as required. The following photos show this process in action.

Azolla being added to cattle feeder, with debris removed (Ramachandran (2014))

Adding rice husks (Ramachandran (2014))

Mixing together with water (Ramachandran (2014))

Cow feeding on fodder supplemented with Azolla (Ramachandran (2014))

Research is now underway at the Tamil Nadu Agriculture University to determine how this plant can be used more widely, considering issues such as nutritional value, scaling up, and limitations to growth potential of the various plant species. They are currently recommending the species *Azolla microfila*, shown in the photo below. (Ramachandran, email, 2014)

Azolla tanks with crops at various growth stages at the Tamil Nadu Agriculture University (TNAU) (Ramachandran (2014))

Azolla crop ready for harvest at the Tamil Nadu Agriculture University (TNAU) (Ramachandran (2014))

Other markets

The Azolla Cooking and Cultivation Project, Erik Sjodin, Stavanger, Norway (Sjodin (2013))

The species Azolla, and other similar species, have been under scrutiny for many years. Recognised for the ease of growth, comparative nutritional value and low cost production, the term ‘Wonder Fern’ referred to in the infographic at the start of the paper has become common. Projects to explore its use have sprung up around the world and widespread use in rice paddies for biofertilisation, management of pests and diseases and reduction of weed growth is now internationally common. (Satapathy and Chand, 2010)

The Azolla Cooking and Cultivation Project (Sjodin, 2013) has been exploring growing methodology, dishes for its use and what the potential is for mainstream use in sustainable food chains. His approach appears to be aimed at home growth and utilization, however, there is no reason for convenience not to lead to a wider market value. The challenge in this aspect is ease of entry and ease of replication (Porter, 2011, pp39-76) which means that in theory the produce cannot be seen as unique.

With resource scarcity issues burgeoning on a global scale, the nitrogen fixing capabilities of the plant become particularly interesting. Currently much of the nitrate requirement for food chains is sourced through manures (muck spreading), supplementary additives (mined minerals) or through natural cycles. As contested environments develop the natural ecosystems are starting to fail and the usual nutrient cycles are becoming less reliable. This has led to discussions around peak nitrate, which has received far less media attention than peak oil. Ironically, there are excesses of nitrates in places, whilst usable nitrates are becoming less freely available, so cost of recovery is likely to increase. (Fields, 2004), (IRRI, undated) and (Townsend and Palm, 2009)

This makes any nitrogen capturing commodity interesting, particularly when the rate of growth is fast and the production cycle is simple; the added benefit in this case is that the water is also left cleaner. The trick will be to bring it to scale in a way that does not consume vast swathes of land and brings benefit to communities where large scale production could be feasible.

These other markets, however, also raise concerns captured in the SWOT and PESTEL analyses. If the plant is highly effective for bioremediation of contaminated water, what risk does this present for the food chain if a water source becomes contaminated upstream? (Rai, 2007)

The analyses

Please see Appendices A to D for the PESTEL, SWOT, Shareholder Value and Sustainable Value analyses models.

With the project still at a formative phase, there are many questions to be considered as the next phase approaches. It is clear that the pilot case is operating successfully and learning has already taken place. The potential scale of looking to move into international markets, however, must not be underestimated.

The social structure for the participants is likely to change as their relative wealth improves and change is know to be a challenge for most individuals. SEEDS must consider what frameworks can be put in place as to be truly socially responsible these impacts need to be managed as much as the operational impacts.

The Environmental benefits are many, with possibilities around improving the nutrient cycles and remediation of wastes inherent in the nature of the project. There are risks around the nature of the fern, however, if it is introduced to new areas, could it begin to choke river systems which previously flowed freely, for example. The disposal of any water from the troughs must be managed to ensure that the plant is contained within the growing systems. It is a case of a positive where it is wanted but a potential negative where it is not.

There are significant potential Social and Economic benefits to the rural areas, with the early phases showing cost reductions for rearing livestock, but if the potential to scale up can be realised the implications for the wider area could be significant if managed effectively throughout the process. For the short term SEEDS should look to produce enough to sell locally, so that not every farmer needs to grow Azolla, but has the option to buy from others. This would be a good foundation for a co-operative network, to enable development of business skills in the short term, before looking to scale up and exploit future markets.

This would also be a good period of time for development of in-house expertise for SEEDS. There are clear indications of interest in supporting the project from a range of benefactors, with only one known to be offering

funding of any significance at this point. The risk here is that volunteer resource can be less reliable which could put the project on shaky foundations. Willing volunteers will bring great value to the project but time available and long term commitment may be limited by other factors. The expertise must be captured and utilised to develop in house expertise and to develop the skills of the women in the field. There is also recognition that the Tamil Nadu Agriculture University has a part to play in knowledge development with knowledge gaps evident in areas such as nutrient retention in the drying process. In the short term this will have implications for storage and use in any periods where growing becomes a challenge, but long term will become critical should international markets be proven to be a realistic option.

The greatest potential is in the women themselves. It should be a key performance measure to assess how they are developing their skills. Are they learning good financial management? Are they learning and practicing sound crop management, which should include monitoring the health of the livestock, the yields of crops which are benefitting from the green manure, the quality of the water being used for growing Azolla etc.

Economically potential structures for any organisation should be explored. Would a co-operative structure work? How would the women communicate across wide areas, what transportation opportunities are available? If a farmer with a small sack of dried material could bring that to market for a fair price, how far would they have to travel to achieve this and what would be the impact in terms of time away from the farm and the family?

The large scale expansion that is detailed further in the next section is a major undertaking. It has been discussed as a potential long term future for the economic benefit of the area and the analyses do show that there is potential for growth of such a market, however, there needs to be a structured process put in place to facilitate a transition as this represents a drastic change to a rural area. Whilst this is not insurmountable, the risk is that partners could import a shift a power if not carefully managed and the needs and opinions of the local people must be considered every step of the way if the project is to ensure that the maximum benefit is received in the Tamil Nadu area.

For this reason, and because the suggested framework is a co-operative, I have used this viewpoint for the Shareholder Value analysis, essentially positioning the rural farmers as the key Shareholders. (Hart, 2010, p.82) This also focuses on shared knowledge bases and the need for a detailed gap analysis to identify training and knowledge transfer needs. For SEEDS the risk is to their reputation as an organisation, so ensuring that the project emerges stage by stage with the core values of social development in mind at all times is paramount. It cannot be stressed enough, the challenges that will come with the ambitious programme that is being considered.

The partnerships that are emerging must also be carefully managed. Each party will come to the table with their own interests in the project and wherever possible these need to be aligned to ensure the best possible outcomes for all. There are frameworks available for management of partnerships and collaborations effectively which would be useful to ensure that large scale projects develop with sustainable models, respectful partnerships and ultimately successful delivery of the desired benefits.

A further consideration must be whether such scale will be wanted in rural communities. The suggested co-operative approach will enable participants to retain as much choice as possible, as opposed to the fast and large scale impacts that a Multi-National Corporation could have. With a co-operative framework it may be possible for farmers to bring their produce to a collection centre for onward sale from there, rather than look to create one single large scale production centre. In this way it may be possible to retain the rural areas, with biodiversity, social and low carbon benefits, yet still ensure that the financial benefits are seen locally.

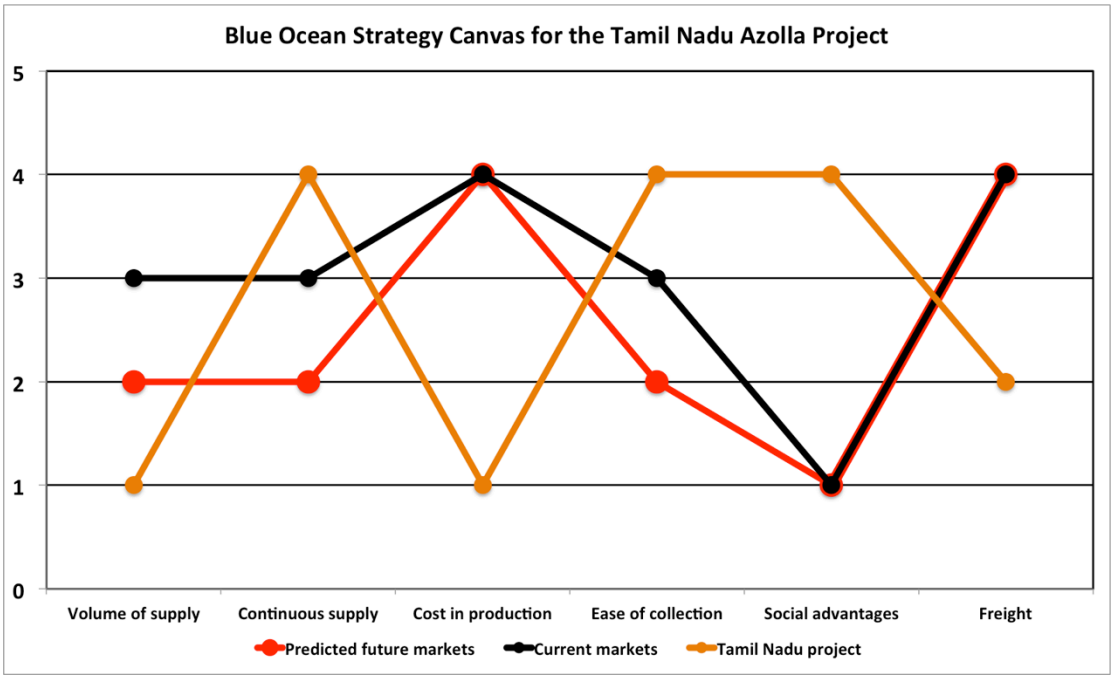
The Growth Path Trajectory section of the Shareholder Value Framework summarises concerns around rapid growth which could be too large scale for the knowledge base currently available. The intention is that by highlighting these, they may be addressed effectively for the most positive outcomes for all concerned.

Moving onto the Sustainable Value Framework, which is an adaptation of the Shareholder Value Framework, (Hart, 2010, p.88) the advantages are clear.

This project is utilising an indigenous plant, in a simple waste free system that has minimal negative impacts. The risks are not so much to the ecosystem but to the food chain, with the need to consider the quality of the water being utilised. The added benefit that if any contamination issues are discovered the plant itself becomes the remediation solution. In that scenario an issue would arise with disposal of contaminated plants as they would have to be removed from the food chain, which would also mean a gap would emerge in the food supply whilst the problem exists. I would recommend that water monitoring kits or methods for checking the quality of the plants be considered for regular testing, and this may also represent a further potential product line to consider. Water testing is not as expensive with modern methods and this would become a requirement if the produce is likely to be supplied to existing markets.

Early indications from the pilot project are that the social benefits are being achieved, which bodes well for wider implementation. The next stage is to explore potential partners who are perhaps looking for ‘Bottom of the Pyramid’ projects to support as part of their Corporate Social Responsibility commitments. It would be critical to the project to ensure that the MNC does not then simply take over and harm the local successes in the name of progress and growth. This leads on to the Blue Ocean Strategy Framework, which considers the ‘what if’ scenario of creating a new market.

Using the Blue Ocean Strategy Framework



(Canvas adapted from Chan Kim & Mauborgne (2005))

To begin with, I put together a canvas to consider areas which could be compared to international markets:

Volume of supply – How much could be provided to the market?

Continuous supply – When would produce be available to the market?

Cost in production – What would the associated costs of farming look like?

Ease of collection – How are harvesting and logistics managed?

Social advantages – Who benefits from the supply chain?

Freight – How is the transport from field to end user valued?

I used three scenarios for this consideration:

The current food markets for a typical food commodity

The potential future markets considering constraints of climate change impacts

The Tamil Nadu Azolla project using a co-operative framework

The outcomes were:

Volume of supply: The project will only produce small volumes at least for the short to mid term future, without significant investment this will not change quickly. The current markets have a reasonably high volume of supply but are constrained by land availability, costs of production, seasonality and so on. In the future markets, with climate change and resource scarcity impacts taking hold the supply is likely to reduce.

Continuous supply: Current markets are effective at maintaining supply even in contested conditions, with forced crops, global sourcing and unfair trading conditions favouring the biggest buyers. Future markets will be impacted by climate change issues, reducing crop yields, wiping out some crop types completely and as emerging markets grow demand on the limited supplies will be greater. A product like Azolla can be produced exponentially wherever troughs can be built and with fast growth in areas that have longer seasons the supply is more easily maintained.
Cost in production: In the natural cycle Azolla is very cheap to produce. Farming is costly and all food produce will remain high cost as demand also increases.

Ease of collection: For local use Azolla is simple to harvest. A co-operative arrangement for collation of excess could make the process relatively simple, although this would be tested at scale. With logistical challenges such as fuel costs and infrastructure in many countries that is not particularly resilient, this will only worsen in future markets.

Social advantages: The current food industry does not operate with social advantages as its core value. With massive MNCs owning supply chains and with others patenting seeds, the value is clearly destined for their shareholders. There is no indication that this will change in the short term. The proposed framework is designed to ensure that the social advantage from Azolla remains firmly with the rural farmers.

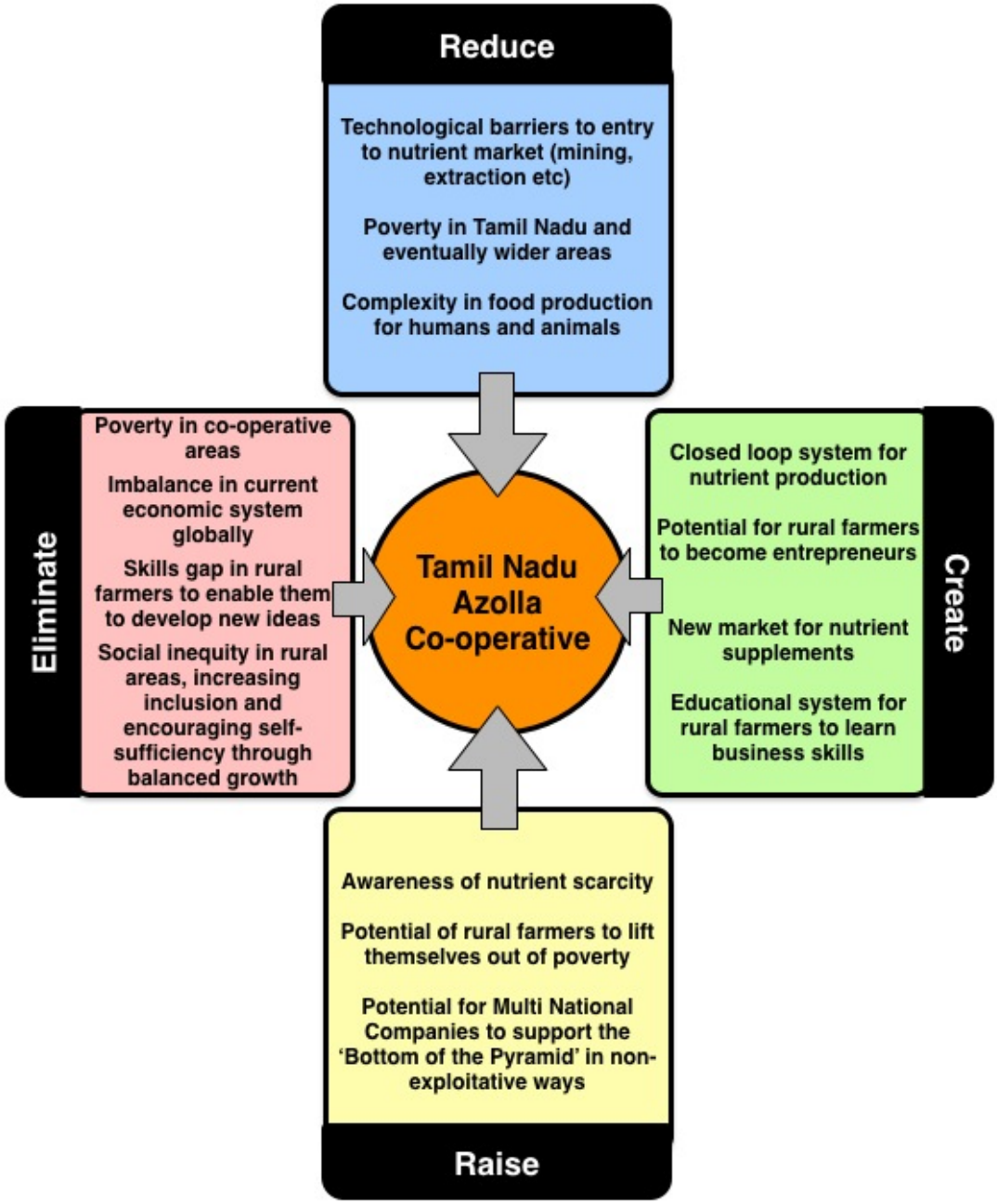
Freight: This was the trickiest element to consider. For Azolla, providing a dry product as a food supplement may be the best solution reducing freight costs and deterioration of the product. To transport fresh produce from a rural farm to a supermarket shelf would be problematic otherwise, and this perhaps represents the greatest challenge to scaling up the project as there is favour for fresh produce, hence the reflection of high logisitics value for current and future markets.

This means that critical decision factors should include how desirable a scaled up model would be to a rural community. To what extent would they consider infrastructure developments a benefit? This would also open up further trade opportunities in the long run but would represent the biggest change to the area overall.
Development of schools and training facilities for adult workers would follow such change, at which point the core of the project may evolve.
The challenge, then, is to determine: who would be the target market for the project? Do the local people simply wish:

- to become more resilient?
- to draw in income from India's economic centres?
- to attract international economic benefits with the risk of loss of control?

The table on the following page shows that all three scenarios are feasible with the right development plan. All the issue raised are entirely manageable, with skills gaps addressed through knowledge transfer and training, better management of nutrient cycles through better understanding and the opportunity to draw in financial support from MNCs.
However, the questions set out above should be answered before any partnership agreements are made and the chance to make a choice has gone. The responsibility for ensuring this happens sits firmly with SEEDS and with the benefit of their previous project experience this should be well within

their scope of capability to manage if the scope of the project is mapped out at this stage.



(Model from Chan Kim & Mauborgne (2005))

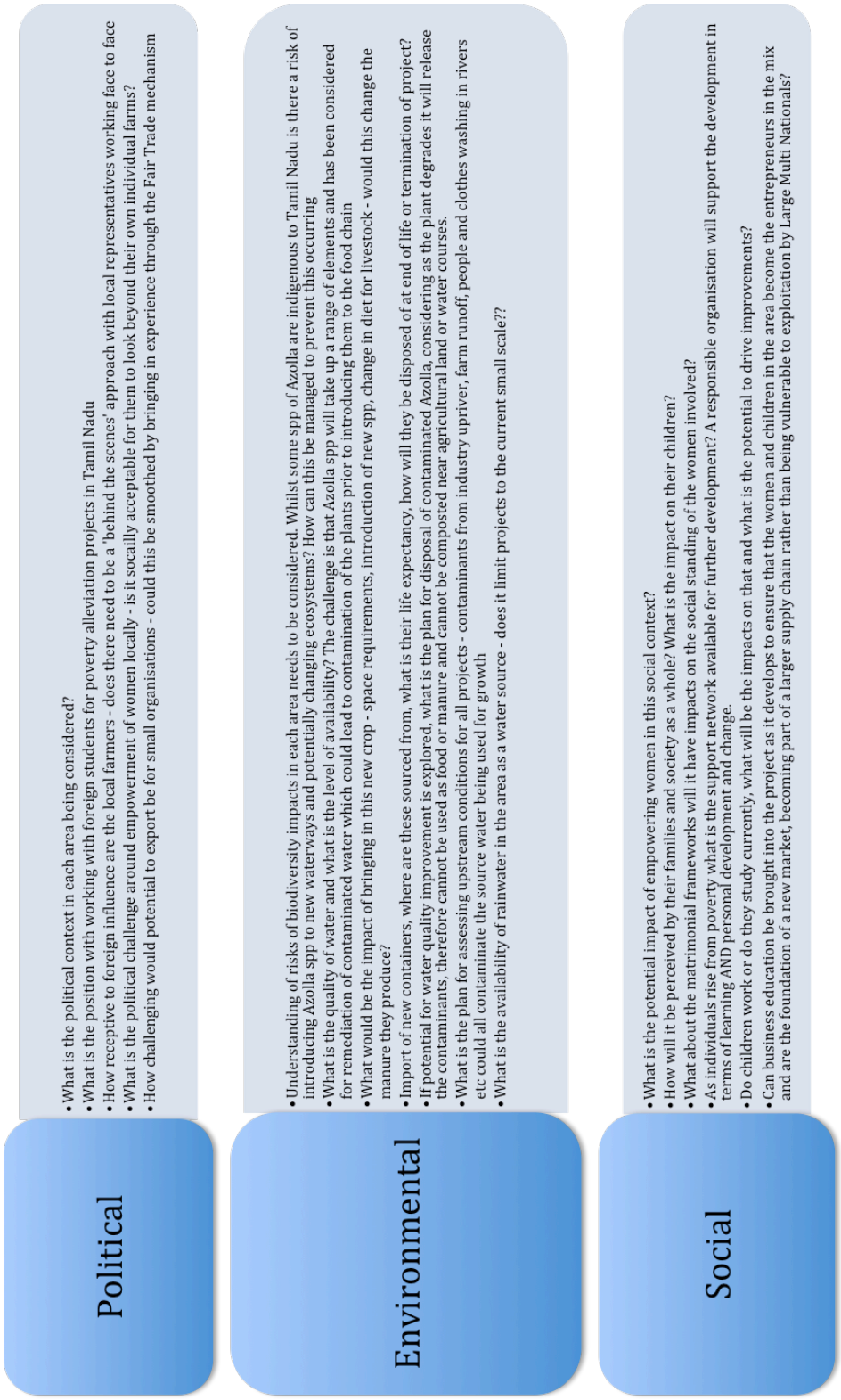
Conclusion

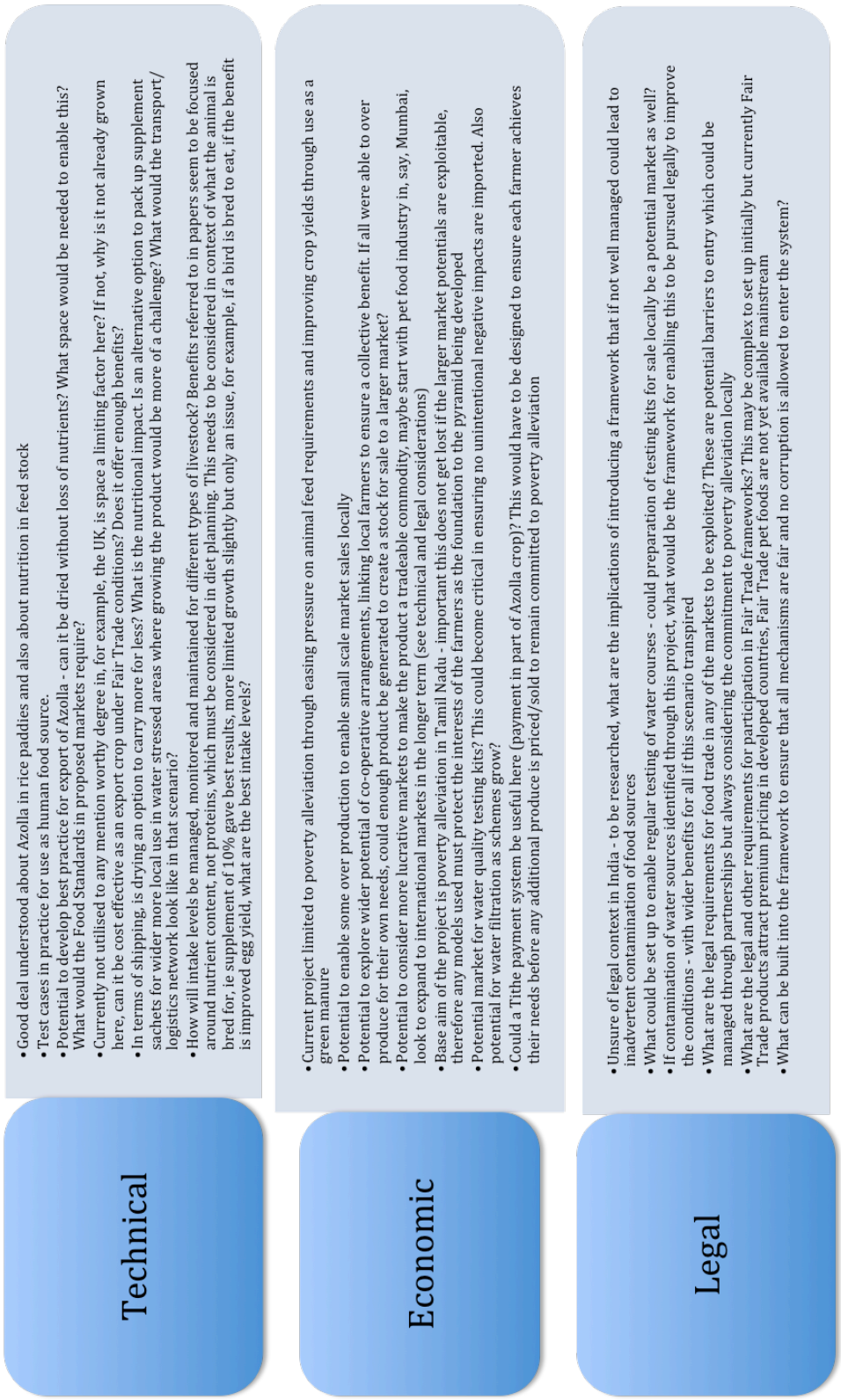
This project is full of exciting potential to deliver great outcomes for its target market. The risks are inherent in the ambition to attract wider markets as traditionally those markets have been set up to exploit supplies for the benefit of their shareholders.

In some ways this represents a great challenge and a heavy responsibility for SEEDS, but awareness at this stage is a very positive thing and enables Mr Ramachandran to hold a position of strength when negotiating any partnership agreements with future partners. It is critical that the boundaries of the partnership are clear, the scope of the project well defined and the progress and outcomes carefully managed as the project develops.

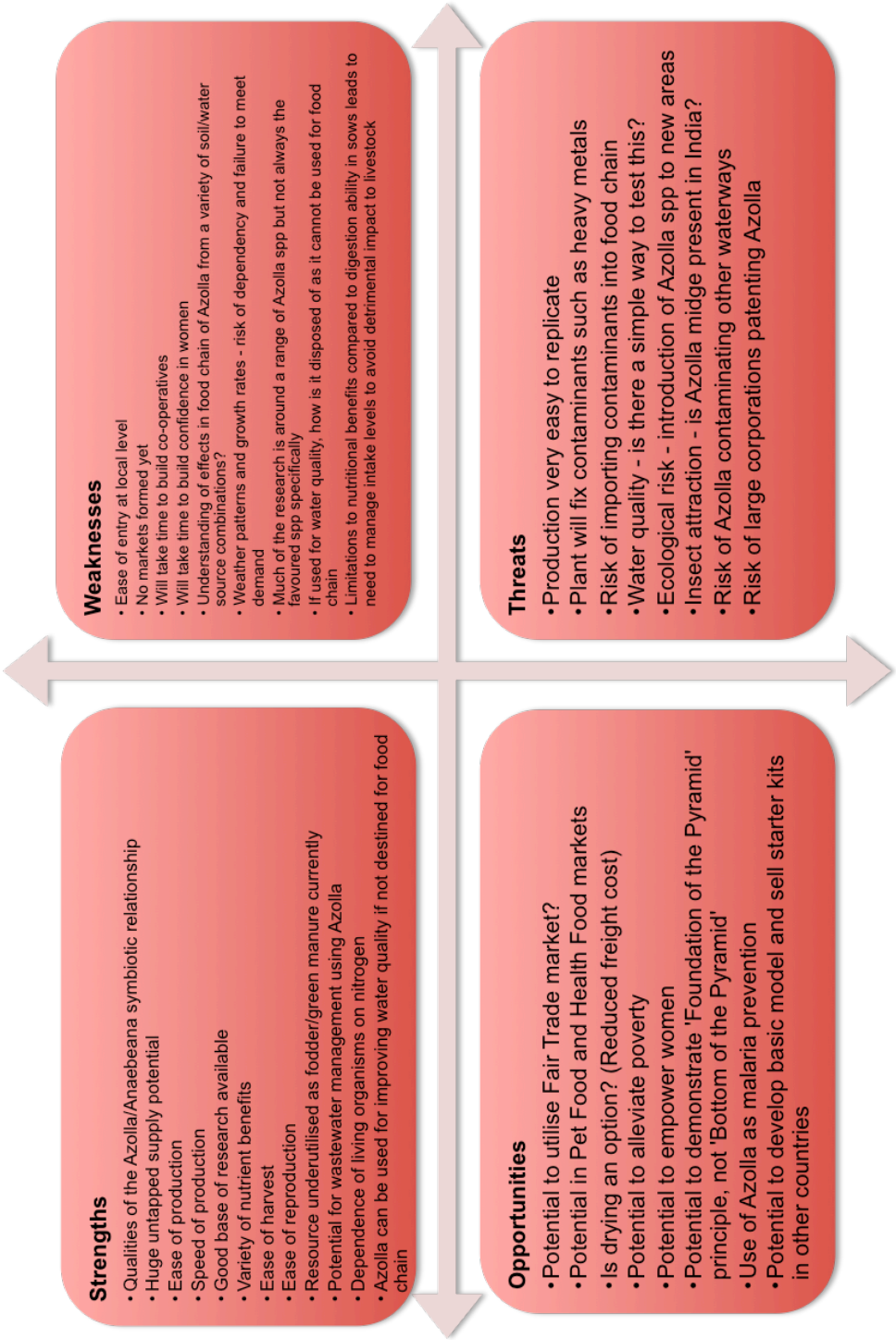
A strategy should not be set then forgotten about. The models provided here should be revisited from time to time and updated as knowledge and experience develop and the entrepreneurs begin to shape their own ideas for their local communities. This will certainly be a project to watch with interest and I hope that the planned benefits are realised.

Appendix A: PESTEL analysis

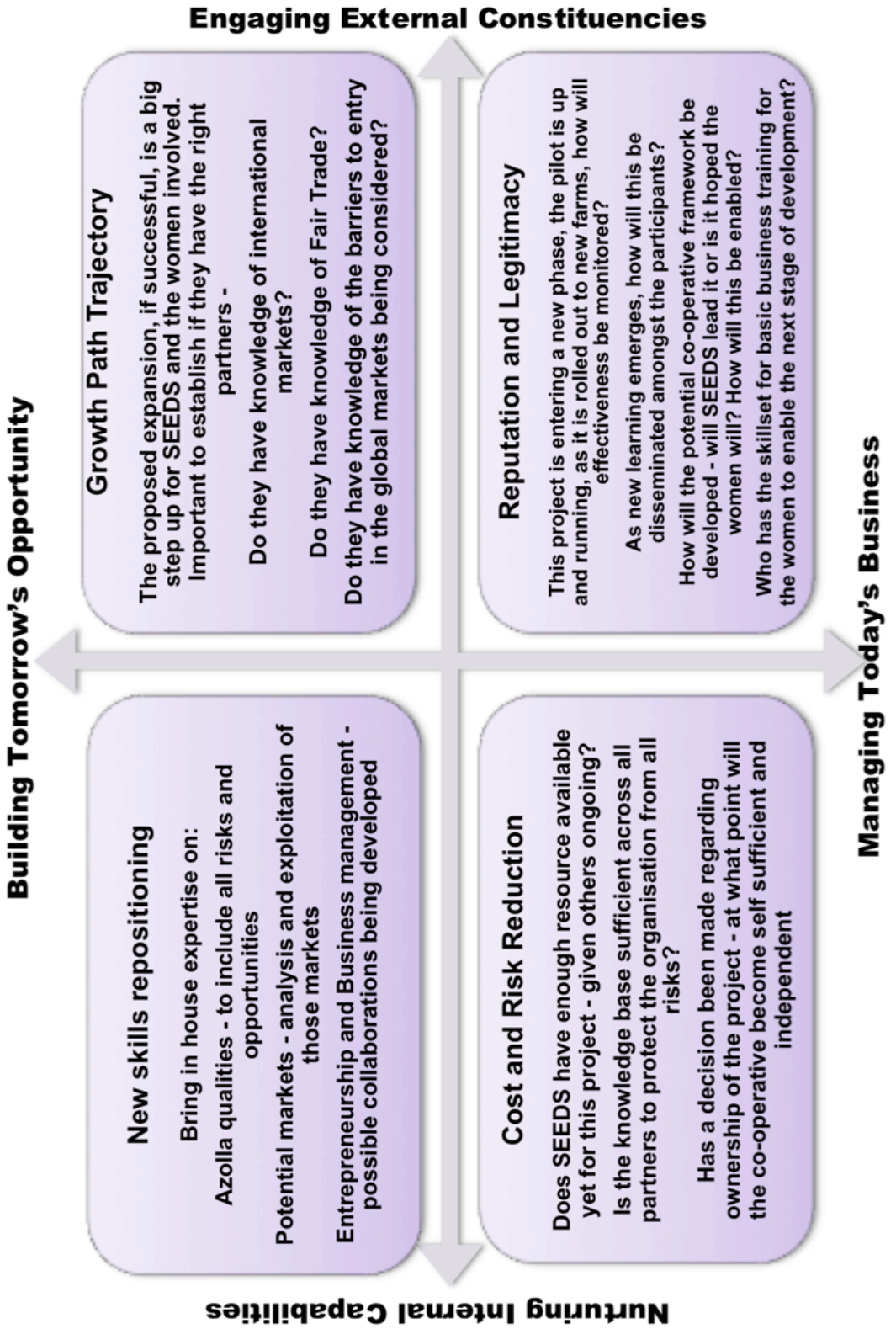



Technical
• Good deal understood about Azolla in rice paddies and also about nutrition in feed stock
• Test cases in practice for use as human food source.
• Potential to develop best practice for export of Azolla - can it be dried without loss of nutrients? What space would be needed to enable this? What would the Food Standards in proposed markets require?
• Currently not utilised to any mention worthy degree in, for example, the UK, is space a limiting factor here? If not, why is it not already grown here, can it be cost effective as an export crop under Fair Trade conditions? Does it offer enough benefits?
• In terms of shipping, is drying an option to carry more for less? What is the nutritional impact. Is an alternative option to pack up supplement sachets for wider more local use in water stressed areas where growing the product would be more of a challenge? What would the transport/ logistics network look like in that scenario?
• How will intake levels be managed, monitored and maintained for different types of livestock? Benefits referred to in papers seem to be focused around nutrient content, not proteins, which must be considered in diet planning. This needs to be considered in context of what the animal is bred for, ie supplement of 10% gave best results, more limited growth slightly but only an issue, for example, if a bird is bred to eat, if the benefit is improved egg yield, what are the best intake levels?
Economic
• Current project limited to poverty alleviation through easing pressure on animal feed requirements and improving crop yields through use as a green manure
• Potential to enable some over production to enable small scale market sales locally
• Potential to explore wider potential of co-operative arrangements, linking local farmers to ensure a collective benefit. If all were able to over produce for their own needs, could enough product be generated to create a stock for sale to a larger market?
• Potential to consider more lucrative markets to make the product a tradeable commodity, maybe start with pet food industry in, say, Mumbai, look to expand to international markets in the longer term (see technical and legal considerations)
• Base aim of the project is poverty alleviation in Tamil Nadu - important this does not get lost if the larger market potentials are exploitable, therefore any models used must protect the interests of the farmers as the foundation to the pyramid being developed
• Potential market for water quality testing kits? This could become critical in ensuring no unintentional negative impacts are imported. Also potential for water filtration as schemes grow?
• Could a Tithe payment system be useful here (payment in part of Azolla crop)? This would have to be designed to ensure each farmer achieves their needs before any additional produce is priced/sold to remain committed to poverty alleviation
Legal
• Unsure of legal context in India - to be researched, what are the implications of introducing a framework that if not well managed could lead to inadvertent contamination of food sources
• What could be set up to enable regular testing of water courses - could preparation of testing kits for sale locally be a potential market as well?
• If contamination of water sources identified through this project, what would be the framework for enabling this to be pursued legally to improve the conditions - with wider benefits for all if this scenario transpired
• What are the legal requirements for food trade in any of the markets to be exploited? These are potential barriers to entry which could be managed through partnerships but always considering the commitment to poverty alleviation locally
• What are the legal and other requirements for participation in Fair Trade frameworks? This may be complex to set up initially but currently Fair Trade products attract premium pricing in developed countries, Fair Trade pet foods are not yet available mainstream
• What can be built into the framework to ensure that all mechanisms are fair and no corruption is allowed to enter the system?

Appendix B: SWOT Analysis



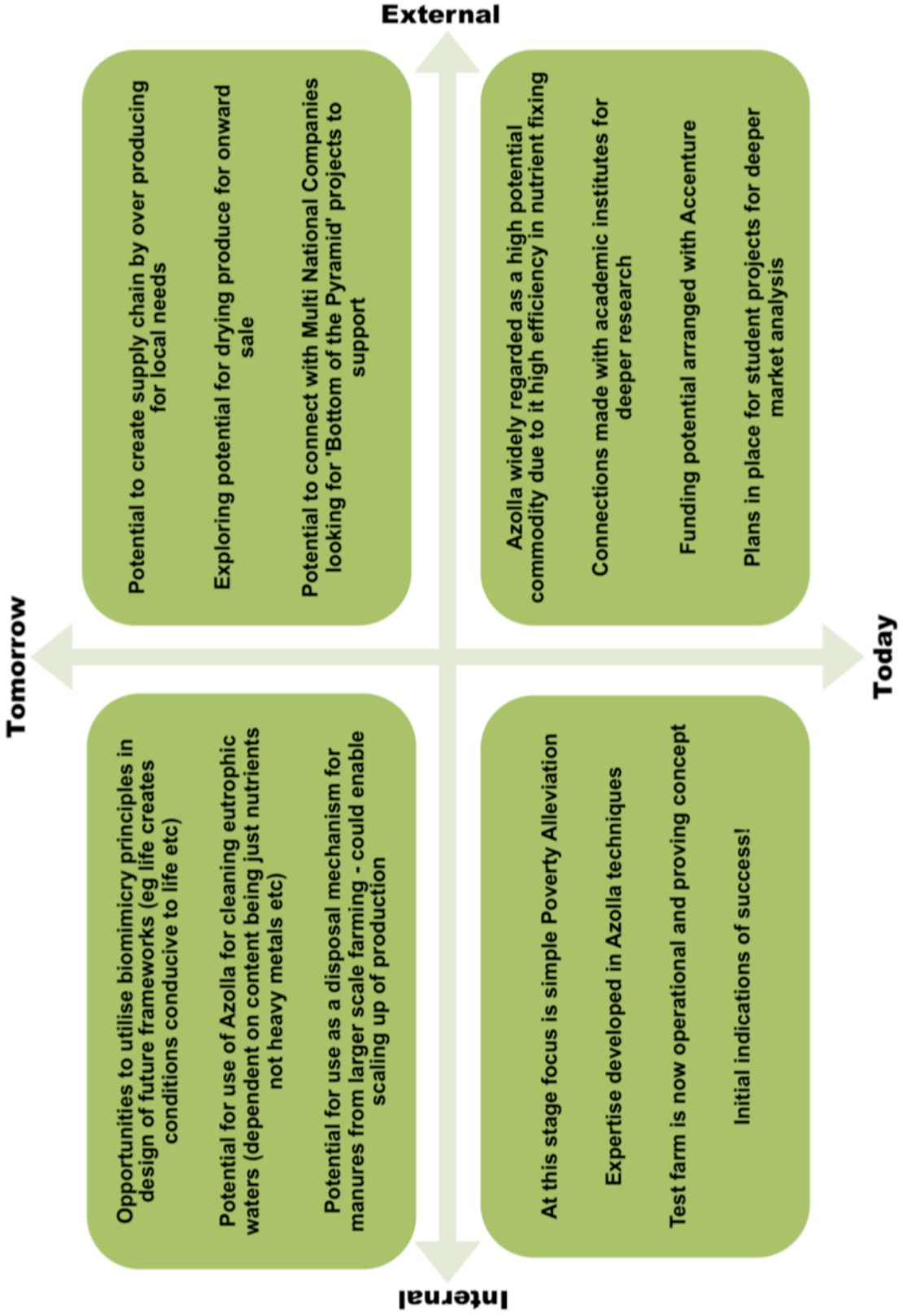
Appendix C: Shareholder Value Analysis



(Adapted from Hart, 2010, p.82)

Appendix D: Sustainable Value Analysis

(Adapted from Hart, 2010, p.88)



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