Costing Flake Fertiliser Production, Distribution and Revenue Potential

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## Introduction

This information is targeted at those concerned with developing solutions to some of our looming global environmental problems. In particular it provides data for scientists who could validate the feasibility of the concept, promoters, policy makers, potential funders and business people. The objective was to ascribe some indicative cost, revenue assumptions, and various relevant calculations, to my separate *Organic Mariculture and Biosequestration* concept paper. No warranty is given as to the accuracy of the estimates, assumptions and calculations, though care has been taken to make them as thorough as possible at this early stage of development.

## Rice Husk Cost and Delivery

Rice husks are a waste product of rice milling operations. Husks have little other economic use and are typically regarded as a disposal nuisance. The greatest concentration of rice mills is off the headwaters of China’s Yangtze River. Typical transportation costs in this analysis are those of barge costs to travel an average distance of 200 kilometres down the Yangtze to a putative flake fertiliser factory in Shanghai. Whilst it may well be more economical to have them transported in bulk form on barges, the costing developed here assumes transportation is by standard, six metre long container. Costing for this is taken from a 2013 case study by Gu and Lam of Nanyang Technological University, Singapore, see <http://www.icms.polyu.edu.hk/ifspa2013/Presentations/L14.pdf>

The rice husks are assumed to be purchased from the mill at a cost of USD $20/tonne for husks that have been processed to a denser and flattened form by a method described in my paper.

The bulk density of these flattened husks is assumed to be in the vicinity of 0.7gm/cm3 or 0.7 tonnes/m3. A standard container has an external volume of 38.5m3. Estimating that its usable internal volume is around 33m3, the result is that it can transport some 23 tonnes of flattened husks. As Gu and Lam estimate barge variable transportation costs in China for a 500 TEU barge to be approximately $0.17/standard container or twenty-foot equivalent unit (TEU)/km, the consequence is that, provided the mill is on a tributary and has barge loading facilities, the cost of transporting the husks to the factory by barge is approximately $1.48/tonne. For comparison, Gu and Lam estimate the trucking cost for a truck carrying two TEUs as $2.00/km.

Allowing more than treble the barge cost to account for flake flattening and baking, loading, unloading, container hire, overhead, incidental expenses and profit margins, we arrive at a figure of approximately $5/tonne to transport the husks to the factory by barge. Thus, the cost to the factory of the delivered husks would be approximately $25/tonne.

## Lignin Cost and Delivery

Bagged lignosulphonate powder currently costs approximately $375/tonne FOB Shanghai. We assume that when pure lignin production ramps up to a comparable level, it will cost only a little more delivered by bulk vessel direct to the Shanghai flake factory, perhaps approximately $400/tonne.

## Red Mud Cost and Delivery

Red mud is a waste product of Chinese alumina production. It has almost no other beneficial use and is costly for the alumina refiners to store, to monitor and to remediate the land containing it. Refiners might even consider paying to have it removed. However, the sources of red mud, and the other fertiliser minerals identified, tend on average to be further away from Shanghai, or from cheap Yangtze River barge transportation than are rice husks. Such sources may require distance shipping rather than transportation by economical barge. Hence, let us assume that the delivered cost to the flake factory is that of its delivered cost by vessel to the factory of $35/tonne, which includes some additional extraction and processing costs of some of the other constituents of the eventual mineral mix selected.

## Flake Processing Costs

These are difficult to estimate as they will depend in part upon the size, throughput and sophistication of the facility, together with the degree to which free solar energy is used in the processing. A best-guess estimate, and due to the simplicity of the processing, these costs could be in the vicinity of $20/tonne of flake produced. Overhead costs, storage and profit margin are included in this figure.

## Distribution Cost

Flake is to be loaded into bulk vessels via conveyor belt, then shipped to a pre-determined oceanic site, whence it is pumped pneumatically out of the various holds and sent through long, differentially angled pipes to arc downwind from the ship into the sea in a wide track. For a given plume of fertilised seawater, this activity is to occur roughly once a year to ensure a sufficient supply of iron-rich fertiliser, which includes other components of silica, phosphate and other minerals. The average total distribution cost to global, nutrient-deficient waters is estimated to be approximately $25/tonne. Some of these vessels may be back-loaded with flake raw materials or other bulk produce, such as coal and iron ore.

## Costs of Independent Scientific Monitoring

Most of the surveillance and monitoring will be performed by unstaffed sensors and vehicles. As both the monitoring intensity and level of subsequent analytical effort are unknown, and as there will be considerable scientific spin-off from such research, no estimate of net attributable cost is provided here.

## Total Cost Per Tonne of Flake Delivered

Excluding net attributable monitoring costs, and using the 60:15:25 suggested ratio for the relative weights of husk:lignin:red mud, the cost of ‘raw’ materials delivered to the ocean surface is thus estimated at $84/tonne of finished flake.

## Revenue Potential

There is a considerable prospect of a substantial revenue stream from carbon credits via carbon registry’s, provided that the requisite authorities allow the independently-validated, deep ocean biosequestration of carbon to generate carbon credits. Using substantial simplifications, it has been calculated that, after losses, the iron in a year’s proposed delivery of flake to iron-deficient global waters could result in the biosequestration of 13GtC in the ocean depths. This would mean that for each tonne of flake distributed and monitored, around 78 tonnes of carbon would be biosequestrated for periods of over a millennium. At a carbon credit price of only $15, this translates to a tradeable credit of $1,170. This makes the potential revenue total from the deployment of $84 worth of flake fertiliser equal to $1,170, less monitoring and brokerage costs. It is realistic to anticipate that at anything approaching such profit margins, business would rapidly seek to bring all prospective ocean areas under mariculture, “doing well by doing good (Lehrer)”.

*These initial calculations identify that one tonne of atmospheric carbon could be sequestered for a cost of $1.08. The potential impact on transitioning, and particularly international negotiations even if that number ultimately proves to be inaccurate by a factor of 20, is considerable.*

## Additional Revenue Potential

Even with high losses, the conversion of buoyant iron fertiliser into marine biomass would theoretically generate a vast increment to oceanic biomass and consequentially to our sustainable marine catch. However, as the magnitude of the potential increase stretches the imagination, it will be assumed instead that the yearly addition of 12.5Mmt of iron only increases our average yearly marine catch of around 94Mmt by fourfold, an increase of 282Mmt. Thus, one tonne of flake that contains around 0.075 tonnes of iron might generate around 1.7 tonnes of additional marine catch for us. Using the 2013 Norwegian fisherman’s average price for herring of USD $0.47/lb ($1.04/kg) as a representative figure, this means that, exclusive of monitoring costs, $84 of flake fertiliser could generate $1,040 worth of additional and sustainable marine catch. The gross margin would need to allow for by-catch, on-vessel processing discards, royalty payments and monitoring costs, but would still be substantial.