Impacts of mining on land and water resources

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Abstract

Mining of energy resources and minerals is clearly the running down of a large but finite, and non-renewable, resource. It is important also to recognise the non-renewable aspects of food production: in particular, net consumption of nutrients and soil as well as the direct and embodied (manufactured capital, for example) energy sources required to convert the soil and water into food (and fibre). The notion that land is being consumed by mining and not by food and fibre production is inaccurate and largely unhelpful if one is to take a whole system view of resource utilisation. Further, the apparent moral high ground of resource utilisation for food as opposed to mining is also questionable. The relative importance of food over shelter and warmth is not clear even at the inner levels of Maslow's hierarchy of needs. This paper gives an overview of demand for energy and minerals, and of potential to supply, to give context for the Australian situation. Some data are presented to examine the hypothesis that Australia's contribution to global development is jeopardised by resource utilisation for supplying energy and minerals as opposed to food (and fibre). The paper concludes by proposing that the current battle between mining and agriculture in Australia includes a significant emotional component. This is based on the romantic vision of ploughed and green fields tenderly stewarded by salt-of-the-earth folk, in contrast to images of earth rent asunder by the ravages of mining under the assault of savages.

Thank you for introducing this topic and giving this conference the opportunity to discuss another major resource user in the landscape. As the abstract shows, I hold the view that people look at these two resource uses, mining and agriculture, through completely different lenses. This paper's overall message is that I think we should unify the way that we look at *all* resource-using activities. We should begin to look for the synergies that can come to people and environments, and start to pull down the 'walls' that we are building at a very fast and, in my view, unnecessary rate.

I will commence by stating that I think sustainable development is fundamentally about (i) intergenerational equity and (ii) meeting multiple needs. On the first point, as a map of country by country GDP would illustrate, it is clear that we do not have equity in the *current* generation.

On the second point, about meeting multiple needs, I would like to refer to the seminal work on this which is Maslow's hierarchy of needs (Figure 1). The important thing to note here is that food is at the same level of needs as many of

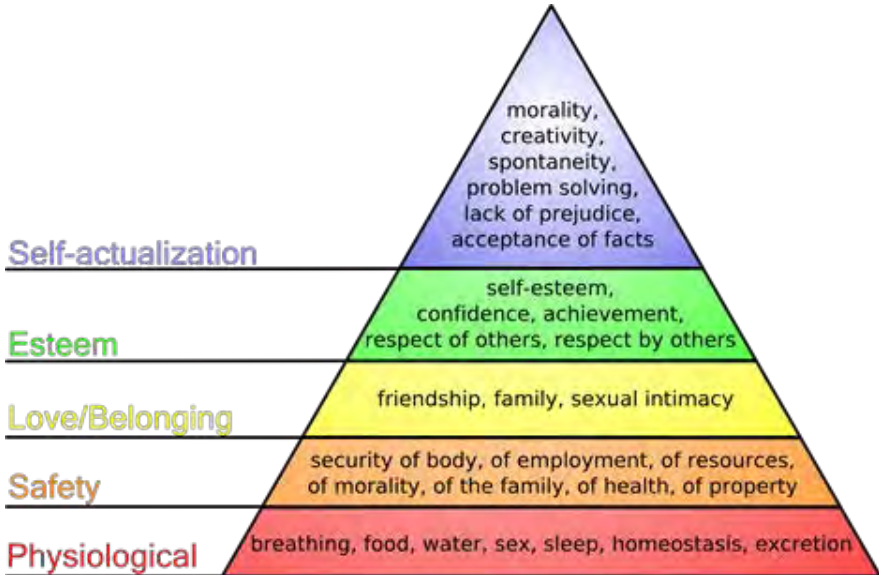

Figure 1. Maslow's hierarchy of needs (Maslow 1954).

the things attained by supplying energy and minerals; that is, warmth, shelter and the ability to consume hygienic food and water.

In 2007 there were 1.3 billion people living without electricity and 900 million without sufficient warmth or food. Is it a helpful trade-off to say it is good to have your stomach full but be cold and in the rain? Instead of a trade-off approach to the challenge, we should be asking: 'Where are there synergies, and what are the true issues here that we need to tackle?'.

In putting together this paper, I started with the view that I would be able to find data to illustrate the competition between mining and food production. To my surprise I was unable to find strong evidence for this being the national-scale issue that the media and some others are depicting. I assert that if we continue with the line that competition is the main problem then we will, within two decades, be dealing with far greater 'wicked' problems than if we make an attempt at integrated resource use and management today.

Wicked problems are characterised by non-linear relationships between issues, feedbacks and uncertainty. They do not have solutions, they only have better (or worse) navigation pathways.

Having removed the *a priori* assertion that food production must be given priority over minerals and energy access, I now pose a number of focusing questions to analyse the depth of the resource competition 'problem' in Australia:

- What is the picture of the relative economic importance of mining and agriculture?

- What are the significant contributions of Australia?
- Where are the overlapping resource competition areas in Australia with respect to food production and mineral and energy access?

Some time ago Rio Tinto, a major mining company, predicted a future that links global development and the demand for energy and minerals. It is well accepted that in the coming two or three decades there will be tremendous global growth, and approximately half of that will be from China and India combined. What Rio Tinto added to these well known projections is a picture of metal intensity per capita for the various metals needed for development: copper, aluminium and iron ore, plus coking coal for steel. Over the GDP levels that the coming growth will achieve we pass through the maximum rate of increase in required metal intensity. This translates into a massive forward decadal-scale demand.

The other side of that is the energy that is required to convert the raw materials into infrastructure that supports development. This demand for metals and energy is coming in exactly the same time period as the projected global food crisis. It is a perfect recipe for rapid development of a wicked problem — that is, if we look at supply from a competitive, rather than a synergistic, perspective.

Now let us look at how energy has been supplied, and the likely future sources. In the last decade we have met most of the increased demand for energy globally from coal, then gas. Renewable energy supplies have increased at about the same rate as gas but at a much lower magnitude. For us to meet the energy demand for development from renewables would require the trajectory to become even steeper than the rapid increase in Chinese energy imports since the year 2000[1] — a very tall order indeed. The alternative is simply to slow down development, which is a moral dilemma of gargantuan proportions: people on one side of the planet deciding that local resource competition for relatively small quantities of water, for example, should drive decision making to constrain the capacity of millions of people to lift themselves out of poverty!

If we look at the supply of minerals we find that there is great prospectivity around the world, and mostly in regions where mining is already prevalent or in new geopolitically-challenging areas such as the Democratic Republic of Congo and Papua New Guinea. Will all this mining turn the world into one massive mine pit? Well, of course not.

There are significant impacts of mining. There are significant environmental impacts of mining; there are significant social impacts of mining. I am certainly not saying that these are not important, or that we should not map them, or that we should not look at them and manage them with the other resource-using activities. However, instead of pointing out all the unpleasant things that happen from mining, and asking 'What are we going to do? I prefer to ask 'How are we going to manage the set of resources we have in front of us? How are we

[1] After a steady increase since 1970, China's energy production in the year 2000 increased rapidly from 1 million kilotonnes (kt) oil equivalent to reach 2 million kt oil equivalent by 2010.

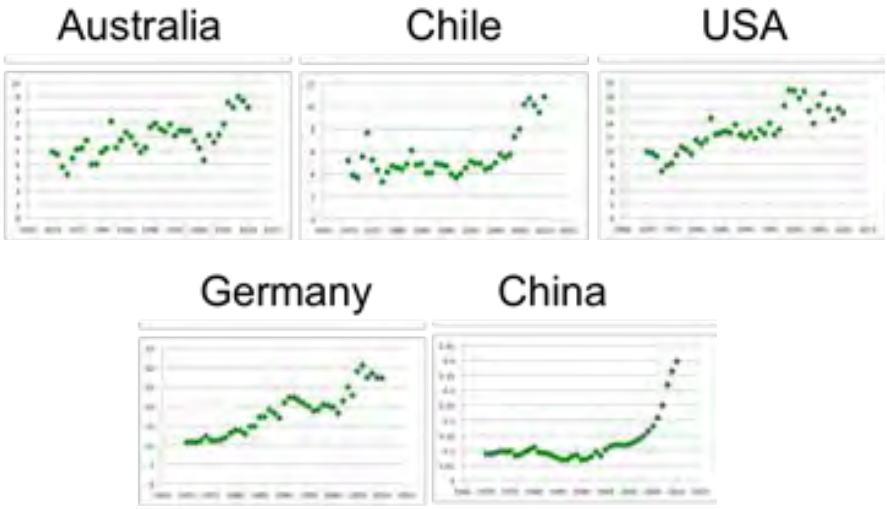

Figure 2. Ratio of GDP of mining (y axis) to agriculture (x axis) in a range of countries from 1970 to 2012.

going to come up with constructs to tackle potential competition? It is certainly feasible.

Mining and agriculture compared

It is interesting to look at the relationship between mining and agriculture across a range of countries (Figure 2). In most of the countries shown, mining has become of increasing importance with time, albeit not at a smoothly increasing rate. The effort of China to produce more minerals can be seen in the steep increase. Unlike some of the other countries, the reason is not global prices but rather a reflection of that drive to develop, which I described above. The step rise in recent years in Australia and Chile, for example (Figure 2), is a reflection of booming prices, also driven by Chinese demand realising supply. It is unsurprising that countries have encouraged mining, reflected by investment and government decision making.

It is equally interesting to look at the relative impact of Australia as an export nation in terms of our involvement in development and overcoming poverty. Australia produces about 1.5% of world wheat, according to ABARES (2011). If we were to export all that into developing countries we could meet, also according to ABARES data, around 20% of those countries' needs. So where do we export to? Well, we export to the USA, European Union, Japan, Korea, the Middle East and Indonesia. We are not actually targeting our exports to feed the poor at the moment.

There a series of arguments that say if we were not feeding these wealthy markets then someone else could not feed the other markets. Nonetheless, as a country with mining–agricultural warfare apparently on our doorstep, what are

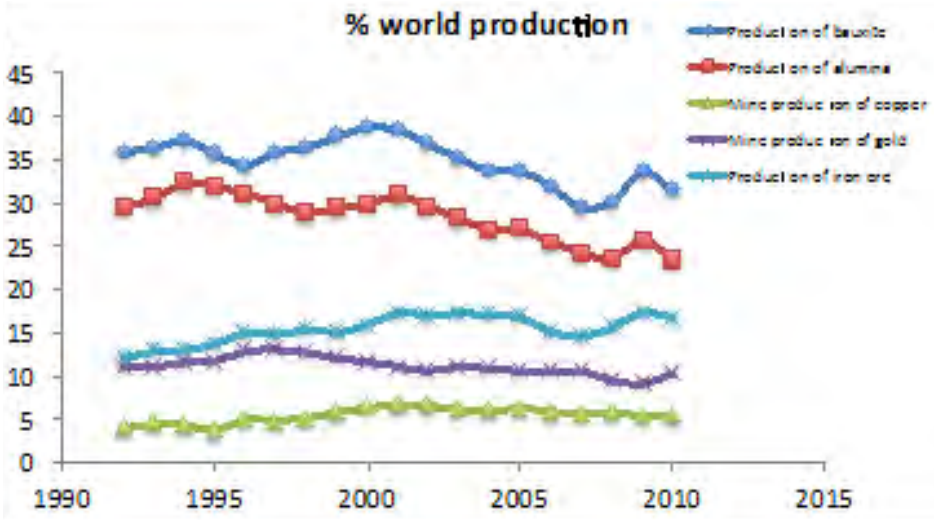

Figure 3. Australian contribution (%) to world supply of various metals: (top to bottom) bauxite, alumina, iron ore, gold, copper.

we doing with the main food that we do produce? We are sending it to wealthy countries. Why? Well they pay, and they pay well. So there is a good economic return to Australia; it is a sensible thing for us to do in our economy.

Cotton is a little different. We do send a lot of cotton to China. It is not food; I understand that it is not food; but it does start to focus on the range of human needs — warmth and clothing. One reason for looking at this alternative need is because it is in some of the irrigated cotton areas that Australia has some issues currently between mining and agriculture. Interestingly, the exports of cotton are quite volatile so our impact on the world is quite volatile.

Now, compare Australia's contribution to the world's supply of metals (Figure 3). For a number of the commodities, we produced a large proportion of the world's needs in 2010, with much of it going into developing countries including China and India. Growth in production has been happening in mining since the 1990s, even though our share of world demand has not grown at the same pace. Iron ore and gas have shown more or less linear growth. We can expect gas to change quite dramatically in the next decade, as a result of offshore gas and coal seam gas coming online in significant quantities. And why do we do that? Well for the same reason.

Figure 4 shows a rather radical increase in the amount of revenue flows — this is only mineral flows; it does not include the energy flow. If you add the exported coal on top of that in particular, you see a significant difference.

What if we put these things together — food, fibre, energy and metals? Why separate them? When we put these things together we can start to ask 'Well where is the base of this economy, and how might we manage the resources that we have, in an integrated fashion?'

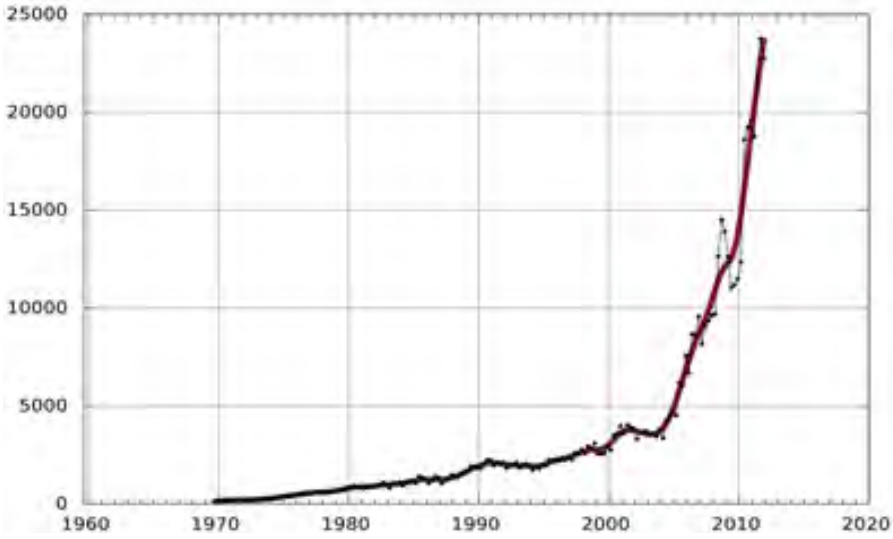

Figure 4. Historical revenue flows from non-energy mining in Australia, in $millon per annum.

An important part of this overall debate is the use of land resources, and land requirements. Figure 5 shows what Australia has been doing with wheat and with cotton. For wheat there was a huge dip in land use around the 1990s, but by 2010 the land required was around 14,000,000 hectares. Now consider how big a mine is. Mines overall may occupy several thousand hectares, but that is a couple orders of magnitude different from the land footprint, the direct land footprint, from wheat.

There are still 'downstream' and 'flow-on' issues, but I do not think there is any argument that the downstream impacts of, for example, a mine and the downstream impacts of agricultural production are fundamentally more or less the same. There are different processes: for instance, mines create voids and agriculture erodes precious surface soil. There are also some similar processes: agriculture acidifies thousands of square kilometres of subsoil and mining can

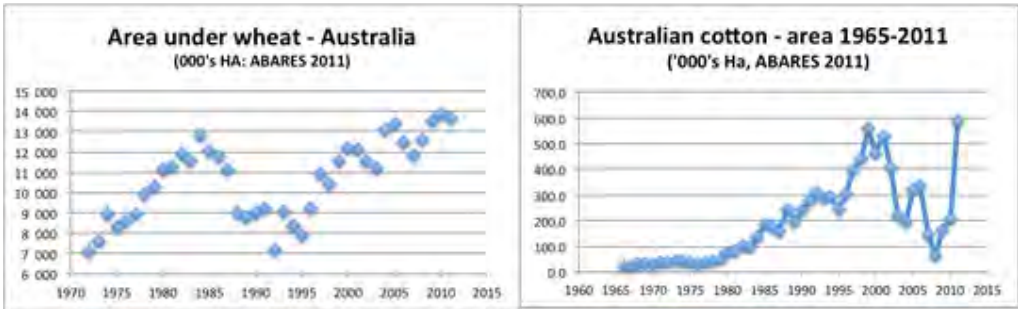

Figure 5. Land area consumed for production of cotton and wheat.

acidify spoil heaps and tailing facilities. Where mining and agriculture exist together they tend to contribute their beneficial and their ill effects together. These are not value judgements; they are measurable and manageable physical and biogeochemical processes.

Social impacts

Where does mining happen in Australia? To what extent are there real issues of overlap and competition? The majority of places that produce large quantities of minerals are actually a long way from agriculture and a long way from water resources that we use for agriculture. We have one very clear and strong example of overlap, and that is in the Hunter Valley in New South Wales. The problem here is that government has permitted major-scale intrusions (mining and other activities) into a landscape, one by one, and we have not stepped back as a society and a government and said: 'Should we look at the collective of what we're doing here?'.

We did the same thing in developing broad-scale agriculture all across the nation. In Australia we just seem unable to step back from these situations and take a simple look at what is going on — and the Hunter Valley is a rather good example of what can happen as a result of that.

My research group has conducted some studies in the Upper Hunter Valley in the Musswellbrook area on the cumulative impacts of mining. We found that the visual impact of mining, the ever-present vista of spoil heaps and roads and dust, created a sense in people that mining was overdeveloped. It was not necessarily that mining companies were not managing the issues at a local level.

Across the town the cumulative impact steadily grew over time, and we saw this by aggregating all complaints data from five mines and comparing that to estimates of visual amenity. It is not always the physical degradation issues that people respond to. What we found was a visceral response: the trigger is the blast, or the light, or the change, or the fact that people see it when they drive around town. Underlying that is the feeling: 'I don't want this amount of activity, this kind of visual assault on me all the time'.

I am not trivialising this issue. It is important, but it is not a 'feeding people in Africa' issue. It needs to be treated properly in proportion to its scale for Australia.

It is important to include coal seam gas in this paper. Coal seam gas changes our view. Its footprint is more like that of a millipede than an elephant, distributed among other land uses across a large area. It presents a new resource-management challenge.

I pose a question: 'Has there ever been a resource-based activity in Australia that could impact tens of thousands of square kilometres, profoundly change the character and availability of underground and surface water resources, generate large quantities of brine on land and in rivers, revolutionise infrastructure and change the face of communities?'

Yes, it is called irrigated agriculture, and I think we probably have not managed it as well as might have. Surely we can learn from exactly that experience and start to ask some of the right questions, instead of trying to set up battle lines!

Conclusion

In conclusion, here are a few summary points.

- Mining is a minor competitor for land (and water) with food production (to meet development needs) *especially compared to food production itself* (e.g. land degradation and 'nationalism').
- Emotional and other social issues abound beyond economic value and land resource occupancy.
- Coal seam gas (and shale gas) production is a new natural resource challenge and an important opportunity for Australia. We are not performing well in the introduction of this resource into our economy.
- Over-generalisation and alarmist communication of potential impacts is not good application of knowledge. It is not evidence-based and it is not going to assist in improving governance and achieving good outcomes. It is certainly not science. There is a critical need for focus.
- Co-resource exploitation, e.g. of soil and gas together, can convert marginal entities into economically successful entities. It is not beyond our capability or knowledge to manage multiple resource extracting activities in parallel. It may, however, be beyond our political capability and our social maturity.

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