biology underlying cancer therapy resistance, particularly that involving EMT. However, a limitation of cancer models can be the genetic diversity of cancers and the fact that they have different cellular origins, which often precludes mechanistic generalizations being made regarding their biology.

For example, RhoJ is also highly expressed in melanoma skin cancer cells, in which it promotes therapy resistance to DNA-damage-inducing agents through an alternative mechanism: that is, it disables DNA-damage sensing and, as a consequence, averts cell death induced by the transcription-factor protein p53 (ref. 12). The skin cancer model used by Debaugnies and colleagues lacks p53, and this might explain the different RhoJ-associated therapy-resistance mechanism uncovered by the authors.

These findings highlight the challenge of dealing with the range of molecular tumour subtypes encountered in the clinic. Future studies should address whether RhoJ-dependent DNA repair and replicative-stress tolerance drive resistance to DNA-damage-inducing chemotherapeutics in other EMT-associated cancers.

Given the prominent roles of cytoskeleton remodelling in cancer progression and metastasis, Rho GTPases such as RhoJ constitute promising chemotherapeutic targets, especially for cancers that are resistant to current treatments[13,14]. Although the identification of clinically effective inhibitors that target Rho GTPases or their downstream proteins has proved challenging, several compounds and lead drugs are showing promise[13]. Their development should continue to be a goal of basic and clinical cancer research.

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Fisheries

Blue foods brought to the table to improve policies

Nanna Roos

What are the benefits of a fish-rich diet, not only for nutrition and health but also for the environment, economies and sustainability? A new framework offers a way to assess the benefits and trade-offs on national and global scales. **See p.104**

Fish is one of the most nutritious types of food and is recommended as part of a healthy diet. But how nutritious it is depends on the fish chosen. The environmental sustainability of aquatic foods, also known as blue foods, varies, but it is generally better than that of terrestrial livestock. Yet, remarkably, blue foods are often absent from the agenda for developing sustainable, healthy food systems.

To help policymakers fill this gap, the Blue Food Assessment (BFA) initiative (see go.nature.com/3z6x5ff) has conducted a series of thematic analyses on the global contribution of blue foods to nutrition, health, the environment, climate and social justice[1–4]. As part of this endeavour, Crona *et al.*[5] present on page 104 a synthesis of this analysis as a framework of four ways that blue foods can contribute to a healthy and sustainable food system.

Why is this work timely? For a start, the diversity of aquatic foods available is staggering. The numbers provided by Crona *et al.* show that more than 2,200 animal species are fished from the deep-water ocean, inland rivers and lakes, for example; and around 600 species are farmed. From small-scale subsistence fishers to industrial-scale aquaculture enterprises, the livelihoods of an estimated 800 million people rely on the sector.

Although the economic importance is undeniable, the nutritional significance of aquatic foods has long been a neglected area in policies[6]. Even in places where malnutrition is high and seafood is abundant, such as Cambodia (Fig. 1), using fish as an alternative to milk to help malnourished children is not mainstream practice, despite its obvious potential[7]. Stakeholders, in Cambodia and elsewhere, need to wholeheartedly embrace and invest in developing solutions that integrate blue foods into nutrition and health policies and strategies.

Crona and colleagues' framework provides a measure for how relevant blue foods are to achieving defined policy objectives. The framework's four objectives are: ensuring supplies of crucial nutrients; providing healthy alternatives to terrestrial meat sources; reducing environmental footprints associated with food; and safeguarding blue-food contributions to nutrition, economies and livelihoods under a changing climate. The framework is unique because it addresses the potential co-benefits as well as the unavoidable trade-offs between these four policy areas, which have fundamental implications for lives and societies.

The BFA group identified the key dimensions of blue foods in food-system transformation that are outlined in the group's thematic analyses[1–4]. A stepwise approach defined the policy objectives and the principles for assessing the blue-food relevance to each objective. By using a method based on logic formulae (true or false for predefined threshold values), the group assessed the relevance of blue-food policy objectives for individual nations. For example, reducing red-meat consumption is meaningful only if the nation's consumption is above a threshold, and increasing the supply of crucial nutrients is of interest only when these are deficient in a certain proportion of the population. The outputs of this analysis classified whether blue-food policies addressing each of the four objectives were 'less relevant', 'relevant' or 'highly relevant' for each nation.

For nutrition, the policy objective was to reduce nutrition deficiencies, but was narrowed down to deficiencies of two nutrients: vitamin B_{12} and omega-3. The authors identified these as relevant nutrients that can be deficient in diets across nations and of which blue foods are a key source, according to the original analysis[3] underlying the framework.

The original analysis also found that other crucial nutrients, such as iron and vitamin A, had little relevance in relation to blue foods globally. However, an estimated 16% of the total calcium available for consumption across nations originates from blue foods[3]. Calcium is present in fish bones, but the nutritional value depends on whether or not the bones are eaten. Some fish have soft, edible bones that provide a source of highly bioavailable calcium[8]. Certain species can be processed into powder, which includes the bones, and used as a food ingredient, for example as an alternative to powdered milk[7].

Policies supporting more calcium-rich blue foods — fish processed with bones available for human consumption — might be worth considering. Much of the fish catch processed to make fishmeal for animal feed is of a food grade suitable for human consumption[9], and if bones are retained this would be a valuable source of calcium. The authors declare the framework to be a first step, and suggest that it can be developed to be more multidimensional and context-specific. It would be interesting to incorporate calcium as a dairy replacement, in a future version of the analysis.

The health-policy objective is limited to the potential for reducing cardiovascular disease associated with high consumption of red meat. Similarly, specific policy objectives are set for reducing dietary environmental footprints and safeguarding food systems. In a future version of the framework, further direct benefits might be included, for example the positive impact of blue foods on cognition in healthy children[10].

What are the lessons to be learnt from the framework? The synergies and trade-offs between nutrition and health, environmental footprints and safeguarding society are discussed and will inform decision makers about the need to reflect on them. A key message is that the tremendously complex aquatic food systems have fundamental implications for life and societies, and that it is possible to break boundaries by combining various policy objectives. What might a policymaker gain from consulting this framework? Decision makers will probably go straight to their country of interest, and will examine the information available in the online dashboard tool (see go.nature.com/3zdtqib).

Out of curiosity, I looked up Denmark to see if the tool could help to inform policies here. Denmark is a small country mostly surrounded by sea, and is reliant on the import and export of food. The food system is dominated by livestock, and meat consumption is high. Much of the fish catch ends up as animal feed.

The framework indicates that blue foods are 'less relevant' for addressing vitamin B_{12} and omega-3 deficiencies because none of these is sufficiently prevalent according to the predefined threshold values. Reduction of cardiovascular diseases is also assessed to be 'less relevant'. Blue foods are 'highly relevant' for reducing climate footprints, because of the high intake of ruminant meats (such as beef), but 'less relevant' to safeguarding the food system, because of the low employment and limited reliance on the sector.

MAK REMISSA/EPA-EFE/SHUTTERSTOCK

Figure 1 | Fish caught in the Tonle Sap River, Cambodia.

Could this information support better decision-making? This is a hypothetical question, but a blue-food decision is currently on policymakers' desks. The European Union Action Plan to protect and restore marine ecosystems for sustainable and resilient fisheries (see go.nature.com/3nbkho2) was announced earlier this year, banning bottom-trawling fishing in large areas of the EU, including Denmark, to protect biodiversity and secure future food security.

How could the policy framework help to inform the decision to support or reject this plan? Decision makers might have to weigh up further factors, such as which fish species are affected, whether consumption will change, and what considerations are involved in terms of the type of fishing gear needed, the catch-by-catch environmental impact, economic value and social impact for coastal communities. Exploring such complexity from the framework outputs would be helpful if 'side roads' could be added to the four main routes.

Similar reflections about the framework emerged after considering the results for Bangladesh. Alleviating vitamin B_{12} deficiency and safeguarding the food system were shown to be 'highly relevant', whereas omega-3 deficiency, and health and environmental footprints were 'less relevant'. This raises questions, which is good, but providing more-complex outputs would also help.

For example, although omega-3 was 'less relevant', the risk of omega-3 deficiency is seasonally prevalent for adolescent girls[11], and inequity in fish intake is high. Fish from saline areas also have higher omega-3 levels than do those from inland habitats[12]. How can a policymaker in Bangladesh use the information that omega-3 is a 'less relevant' objective, when the picture on the ground is so complex?

Simplifying blue-food complexity into four ways to achieve the goals of more nutritious, healthy, environmentally sustainable and just food systems is a highly ambitious task, and Crona and colleagues' work is an important first step in opening the dialogue about how to integrate blue foods in food-system transitions. This impressive framework has the potential to set the stage and make a difference in changing the way blue foods are thought about in the context of food systems.

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