

# The role of genomics in the developing world: present and future.

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Since the beginning of time, the search for new knowledge has guided most of the scientific breakthroughs. These discoveries, as genomics do today, have helped mankind to understand and control the world it lives in. Biotechnology is one of the most precious descendants from the genomic era and has become a useful tool in tackling economic and health-related problems. Although the knowledge and technology that comes with genomics are not universally distributed, some developing countries have made great advance on these fields. In spite of all the progress that genomics might bring, developing countries and the entire world should make a deep analysis of the possible outcomes of, for example, the introduction of genetically modified organisms. The scientific delay that most developing countries are experiencing is also an important issue. The globalisation of information and possibilities for these less fortunate people is essential to overcome health and economic problems that are affecting the world's population and that requires urgent attention.

Genomics...what does it mean? While the question arises in my head, a lot of definitions echo in it too. It is impossible to give an exact meaning, especially if we consider that this new aspect of human research is not universally distributed. Indeed, genomics have different definitions depending on where and when do we ask about it. Undoubtedly, it have become a powerful word. It gathers, in my opinion, three important aspects of modern life: the passion for seeking *new knowledge*, where research has no commercial purposes; the brand new world of *biotechnology*, that pursuits solutions mainly in health and industry; and *ethics*, for which both the scientific and non-scientific community should deeply care about.

From the three of them, biotechnology is becoming the most promising in addressing economic and health issues that affect the world's population. Market forces that make use of biotechnology have driven most of the recent scientific breakthroughs. This direct descendent from the genomic era is being widely used not only by developed countries, but also by developing ones.

## Genetically modified coffee for two, please

One example of this is Brazil, the biggest of all South American countries. Brazilians have sequenced the *Xylostea fastidiosa* genome<sup>1</sup> and the coffee grain genome<sup>2</sup>. The former was an important and key project born by necessity: this pathogen is an invader of citrus and coffee plants among others, causing water stress and nutritional problems that affect productivity. This information will give Brazilians better control over this plague, the effects it has on different species and, in particular, on coffee plants<sup>1</sup>.

Secondly, the newly acquired knowledge about the coffee genome will give Brazil the capability of creating a much better quality coffee, with richer taste, smell and more resistant to diseases and climate damage<sup>2</sup>. Taken together, these projects would have an effect of synergy over coffee production.

However, the most important impacts of these conquers is that Brazil's economy would eventually improved thanks to biotechnology (by increasing primary goods' value) and that new discoveries will bring confidence in national science, making Brazilians proud of their scientific goals. Nevertheless, the full potential of these achievements attributed to genomics would

increase to a yet unimaginable point with the post-genomic era discoveries.

### **Genome medicine: Mexico does mind its own genes**

Another example that deserves to be mention is Mexico. Despite all health-related and economic problems Mexico has had for many years now, this country has redirect its main objective from investing in treatment facilities to creating new technology based on genomic medicine<sup>3</sup>. Even though this may appear as a divert of money from more urgent health issues, the promising enterprise focuses on the improvement of people's health and social welfare and also the reduction of the health budget by developing new strategies for prevention, early diagnosis and more effective treatment that make use of genomics breakthroughs and promise to make new ones.

Mexico's modern population has a unique genetic structure caused by a complex admixture of several native groups, Spaniards, etc. Although some developed countries have created programs to improve their health systems, it is clear that Mexico, based on its population complexity, needed its own consortium. The foundation of the INMEGEN (The Mexican Institute of Genomic Medicine) was motivated by the needs and health demands of Mexican people, for whom imported technology would not be completely adequate. Apart from the technological advances, they have made forums and public debates (some of them were even broadcasted on TV) in which the entire population could have access to information about medical and legal aspects on this topic<sup>3</sup>.

### **Hazards to biodiversity**

But together with the industrialisation of the genetic resources, third world countries must face the fact that biodiversity could be strongly compromised. It is surprising that even though agricultural biotechnology has been developed by companies from the industrialised countries, the world's production on GM crops were concentrated in the United States, Canada, China, Brazil and Argentina, where the last three could be considered as developing countries. It is also amazing that Europe lacked this agricultural activity for many years while developing countries, like the ones mentioned above, experienced a rapid introduction of them. Legislation on the introduction of GM organisms are thoroughly analysed in Europe, mainly because of a common discomfort towards this new biotechnology and the hazards it could bring both to the population and to biodiversity<sup>4</sup>.

Whereas European countries discuss this topic with far more concern, third world countries governments remain silent. In developing countries legislation is being analysed *while* GM crops are being introduced, most of them by companies from developed countries. These companies take benefits from the legislation delay and they introduce GM organisms without any previous investigation of the environmental impact it could cause. Developing countries must take strict control over this issue, as the disturbance of the biodiversity could be a catastrophic disaster of universal dimensions. The world's population has to be conscious that today's solutions could be tomorrow's problems. Introduction of GM plants and animals must be done according to the highest control standards. Consequently, ethics and consciousness about the possible outcomes should be taken into consideration by governments, scientists and farmers as well. Positive and negative consequences must be analysed thoroughly in such way people could trust in a profitable and friendly biotechnology. In tackling this matter, information plays a key role: it is imperative to keep a fluid dialogue among all parts involved and to provide clear and up-to-date information on the topic.

### **Inequality**

Brazilians and Mexicans have made great progress in the field of genomics and biotechnology. Such an initiative on scientific research projects represents an example of determination and capability of the third world population and deserves, in my opinion, deep admiration. Unfortunately, this is not the case of the rest of the developing countries, which have not harnessed the full potential of their genetic resources mainly due to the common bottleneck of economic restraints. Developing countries, especially in Africa, are facing devastating health problems that affect their people deeply. Such problems cannot wait for consortia to be formed. According to these, genomics, the new science of life, has created a deeper gap between the rich and the poor. This becomes evident in the analysis of the so-called '10/90 gap', where the 90% of the world's research funding are spent on health problems that affects only 10% of the world's population<sup>5</sup>, which is mainly concentrated in the developed countries. As it happens in health research, agricultural research funding is unequally distributed as well. More than three quarters of the GM plantations are destined to reduce manufacturing costs and to increase the production income of the developed countries<sup>6</sup>.

What is more, most of the research is carried out by the private sector, which causes limited access to information. Is this mainly, and not the power of creating a GM organisms, which broadens the gap between the two worlds by the widening of the molecular divide.

### What can be done to change the future?

The fact that developing countries are being left behind in the genomic era is a vicious circle: they are poor so they cannot afford scientific research therefore they cannot develop biotechnology that is why they are poor and so on. Consequently, it is a world's responsibility to change something about the hopeless reality of these countries by cutting the vicious circle somehow. If the intervention of more scientifically and economically powerful countries is suggested as a solution, it will have to be done under the clearest and most honest aims: help developing nations overcome their difficulties.

Some solutions to these matters have been suggested: developing countries that have achieved an advanced position in genomics, such as Brazil, China and Malaysia, would serve as examples for the less advanced ones. Other suggestions involve the promotion of consortia between first and third world countries. Indeed, most of these consortia are actually successfully working (like the Asia-Pacific Health Research Forum) and have gained great respect among the scientific community and the world<sup>7</sup>. Either one or the other, it is essential that solutions represent a helping hand that guides but not pushes. Developing countries need to be guided, supported by experienced people and afforded by multinational non-profitable organisations that could help them achieve their goals without delay, as the problems these projects are aimed to solve cannot wait. Any extra minute is another third world child who dies from starvation or an infectious disease for which medicines could be provided if he or she would have been born in Europe or the US. Despite all these facts, it has to be clear that the urgent assistance must also be temporary. Developing countries need to learn from these situations in order to be scientifically independent and to self-sustain their health system and economy in the future.

Genomics have a great potential for improving health in developing countries. Recently, the top 10 biotechnologies that could help addressing these matters have been listed, and some of them are available and relatively low-cost technologies (such as PCR for diagnosis of some viral infections)<sup>8</sup>. The introduction and use of these technologies represent a new strategy to save more lives by enabling early diagnosis and

better and more specific treatment, as these techniques promise to be more accurate, providing physicians with more specific information about a patient's disease.

Developing countries also need to cover a great deal of internal demands that require a solid economic platform. Genomics, through biotechnology, could help these countries to overcome some of these difficulties. They need to identify the most promising technologies that are within their possibilities and make them their strengths. By doing this, they would be able to empower their industrial capability and to make full, but conscious profit from natural resources. It will also be important to tackle possible barriers to the application of the newly developed biotechnology, including from government policies to technological appliances.

In the future, more genomic breakthroughs will be achieved and more biotechnological frontiers will be conquered. Equal conditions on the availability of these resources to the entire world are imperative, so every single country will be able to make full use of science. In order to fulfil this, developing countries should prepare themselves by investing on education, preparing their future generations to handle and exploit the new technology. As education is an important percentage of a country's income and its improvement could represent a divert of money from other more urgent issues (such as health), encouragement for exchange of knowledge and experience between developed and developing countries is essential.

Not only the technical training on genomics and biotechnology but also on different aspects of the genomic development, such as bioethics and creation of genomic policies, is decisive for developing countries to take part in international debates and negotiations.

Now it is the time for commitment, to take an oath for the sake of all human beings. Genomics cannot be somebody's luxury; it must be a universal right.

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