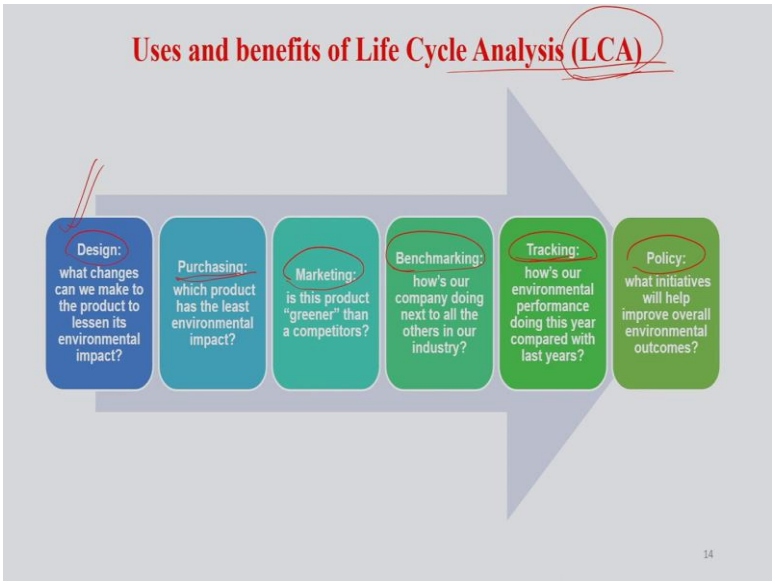
Natural Resources Management (NRM)
Professor Sudip Mitra, PhD
Centre of Disaster Management and Research (CDMR)
Head, School of Agro and Rural Technology (SART)
Discipline - Agriculture Engineering
Indian Institute of Technology, Guwahati, Assam, India
Week - 07
Lecture - 42
Environmental Impact Assessment – 02

(Refer Slide Time: 0:34)



So, in continuation of the lecture environmental impact assessment. Today we will discuss about the various uses and benefits of Life Cycle Analysis. Now, we discussed already what is Life Cycle Analysis, how LCA actually is carried out. Now, the benefits of LCA if you look at it helps in design means what changes can be made to the product or outcome of your project to lessen its environmental impact. So, design aspect is helped by LCA.

Purchasing; which product has the least environmental impact? So, LCA will also you know help you to identify that.

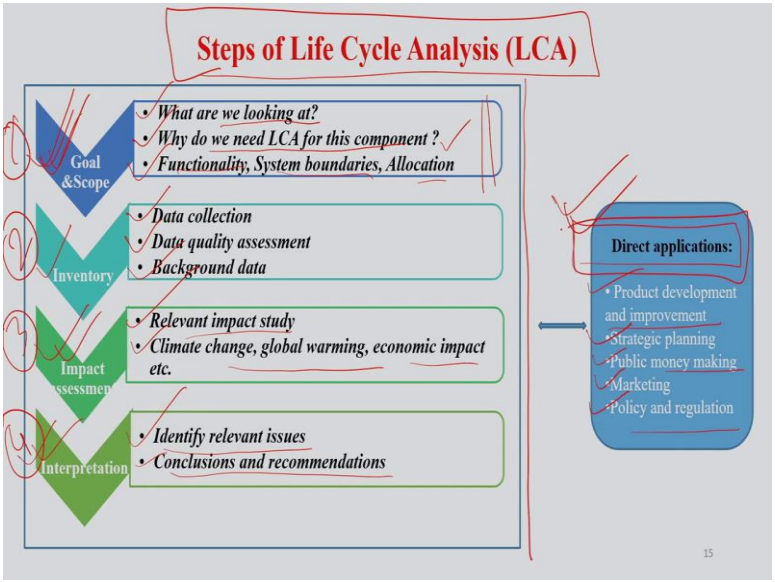
Marketing. Which product is greener than its competitors? Suppose you have 3, 4 different products; you know options of a single product which you want to buy for market. Now, LC also allows you to find out that which product actually utilizes least amount of you know environmental resources or natural resources. That means which one is greener than its competitors.

Benchmarking, how our company is actually performing in comparison to the others in a particular industry say for steel. So, how one company is performing in comparison to the other companies who all are actually you know working in the field of steel. So, that also can be you know understood by LC analysis.

Tracking, how our environmental performance is actually is doing this year in comparison to the previous years. So, that tracking also is possible through LC analysis.

Finally policy, what initiatives what kind of new interventions will help to improve the overall environmental outcomes that can also be identified with the help of LCA. So, you see that how Life Cycle Analysis assists us identifying the design, purchasing, marketing, tracking, benchmarking and finally also to find out which policy actually helps for better Environmental Management.

(Refer Slide Time: 2:50)



So, when you actually decide to carry out this LC analysis we need to know the various steps that are followed in Life Cycle Analysis. Now, the first is your goal or the scope of this analysis. What actually under goal and scope we look for. What are we looking at? What actually we want to do? Why do we need LCA for this particular component? That also we need to ask ourselves. Functionality, system boundaries, and allocations, these all comes under goal or scope of your LC analysis.

Once goal and scope is clear then we go for inventory and in inventory what we do? Data collection, data quality assessment, background data. Now, these data collections all these things already discussed in earlier lecture and you know that how you know we can collect

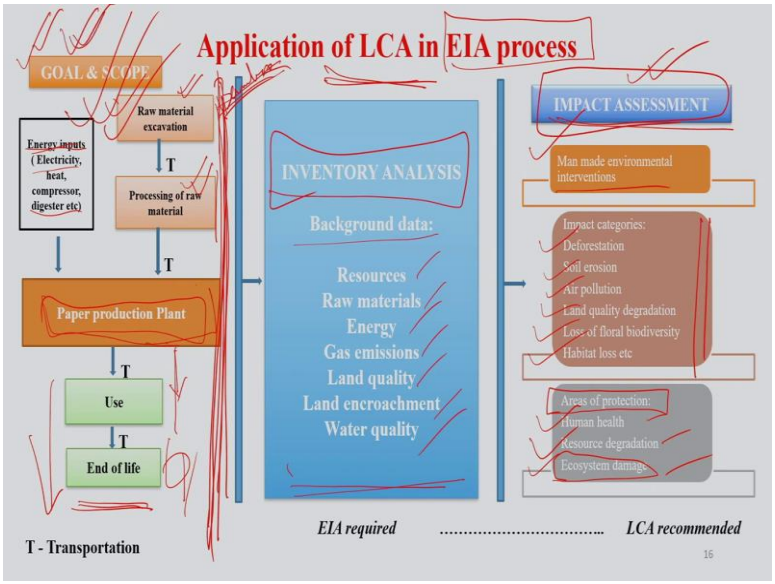
environmental data. So, inventory is largely about data management; data collection to data quality assessment etcetera.

The third step is impact assessment, where you carry out relevant impact study, climate change, global warming and economic impact etcetera analysis also carried out.

Finally, interpretation; interpretation of the analysis or the outcome of this LCA. What you do? Identify the relevant issues and finally we give conclusion and recommendation.

So, all these steps basically you know allow you to apply LCA. LCA for product development and improvement, strategic planning, public money making, marketing, policy and regulation. So, these are the direct application of LCA which you carry out by these different steps that I have just mentioned here.

(Refer Slide Time: 4:57)



So, I hope this is clear that what are the various steps we need to carry out to finally get this kind of application through LCA. Now, we come to the application. Application of LCA in environment impact assessment process.

Let us look at in two aspects, one is goal and scope the other is impact assessment. Now, when we talk about goal and scope here actually, we start raw material excavations, any kind of raw material.

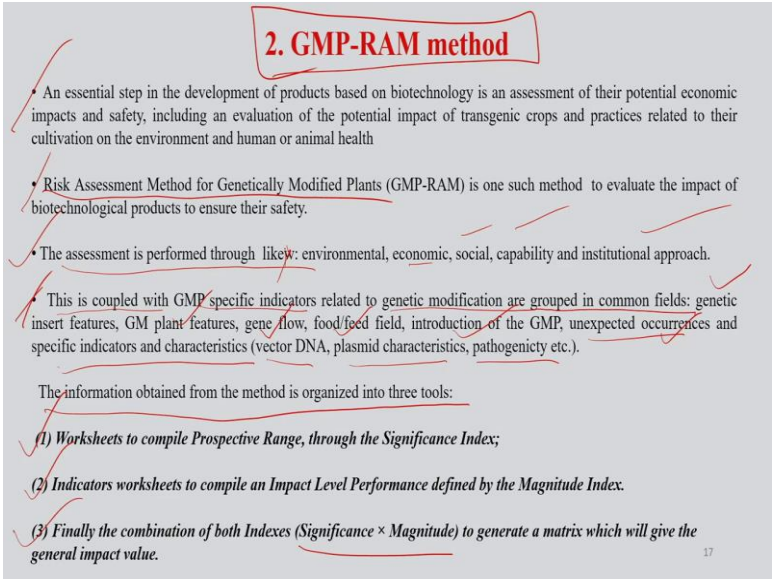
Say paper if you consider, so the raw material is bamboo. Then you process, then you go for a paper production plant unit, then you produce paper, you use it and finally the end of its life of the product. Now, while doing so definitely we need energy, different kind or form. We

need also various other inputs to bring out to this ultimate product and then use and then finish. So, entire you know life cycle. Now, from here this is your goal and scope.

Now, once this product you know utilization also takes place an end of life of that product here the paper. Now, what actually happens in this process? If you go for now the EIA of this particular product development process then what we find, we find that impact assessment can give you man made environmental interventions that is taking place here. The impact of this product development process can be divided into various category; deforestation of say bamboo, soil erosion because of removing bamboo from the system, air pollution from the industry from the plant, land quality degradation, loss of floral diversity, habitat loss these are different kind of potential impact and what are the areas that you try to protect? Human Health, Resource degradation, Ecosystem damage. Now, each one of these we have discussed in one or other point in the previous lectures you understand that how actually this kind of impact takes place. Now, how we actually analyze this impact for this particular process system is through analysis of LCA.

Now, for that we need data collection just now in the previous slide I mentioned. We need various kind of data, resource data, materials, energy, gas, land, land encroachment, water supply, etc. So, ultimately what you do you actually carry out an LCA,Life Cycle Analysis to come out with a environment impact assessment of an process or product development process clear.

(Refer Slide Time: 7:49)



So, let us go to the next one GMP-RAM method this is you know another method here actually what is done is that it is an essential step in the development of you know product

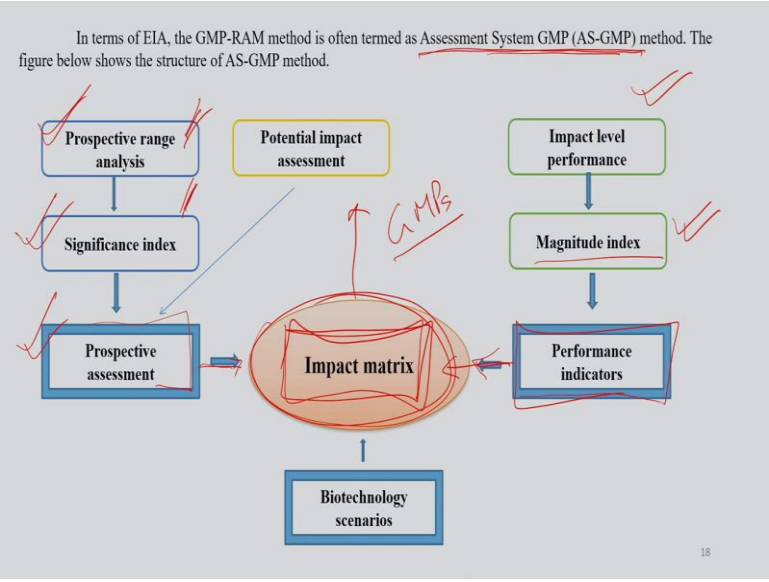
develop product processes which are basically you know based on biotechnology and it also includes the evaluation of the potential impact of various transgenic crops practices related to their cultivation on the environment as well as human of animal health.

Now, here risk assessment of GMOs here Genetically Modified Plants we are talking about is one such method to evaluate the impact of biotechnological products to ensure their safety. Many debate many deliberation you might have seen or read in newspaper and other forms of media. This kind of assessment is performed through environmental, economical, social, capability and institutional approaches.

Now, this is coupled with GMP specific indicators related to genetic modifications are grouped into various fields which are those? genetic insert feature, Genetically Modified Plant features, gene flow, food and feed, introduction of GMP, unexpected occurrences and specific indicators and characteristics like vector DNA, plasmid characteristic, pathogenicity etcetera. So, these are actually all observed under Genetically Modified Plants and RAM method.

The information which is obtained from this method is organized into three tools. One, worksheet to compile the prospective range through the Significance Indexes. Second, indicators worksheets to compile and impact level performance defined by the Magnitude Index, how much its actual impact. Finally, the combination of both Indexes Significance and Magnitude to generate a matrix which will give us the general impact value clear.

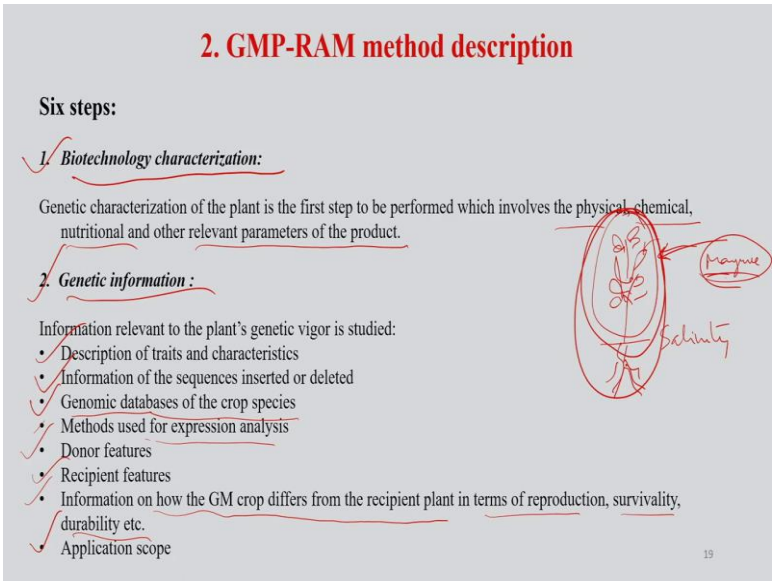
(Refer Slide Time: 10:09)



Next in terms of EIA the GMP-RAM method is often termed as Assessment System GMP or AS-GMP method. These diagram in this slide shows the structure of AS-GMP method; how it looks like. Now, the different range of analysis is including significance index analysis and prospective assessment. Now, this prospective assessment will be carried out of course in the basis of significance indexes and prospective range analysis.

Once this is done then it goes into your Impact Matrix analysis and on the right hand side where you are studying the impact level performances, here you use on the basis of magnitude index you actually come down to different performance indicators. This performance indicator also plays a major role in the Impact Matrix formation. So, in Impact Matrix formation your prospective assessment outcome and performance indicators based result will come in and finally you will get that what kind of impact because of introduction of you know certain GMPs is actually creating on the environment or on the surrounding other organism in the ecosystem. So, these methods are known as Assessment System GMP method all right.

(Refer Slide Time: 11:55)



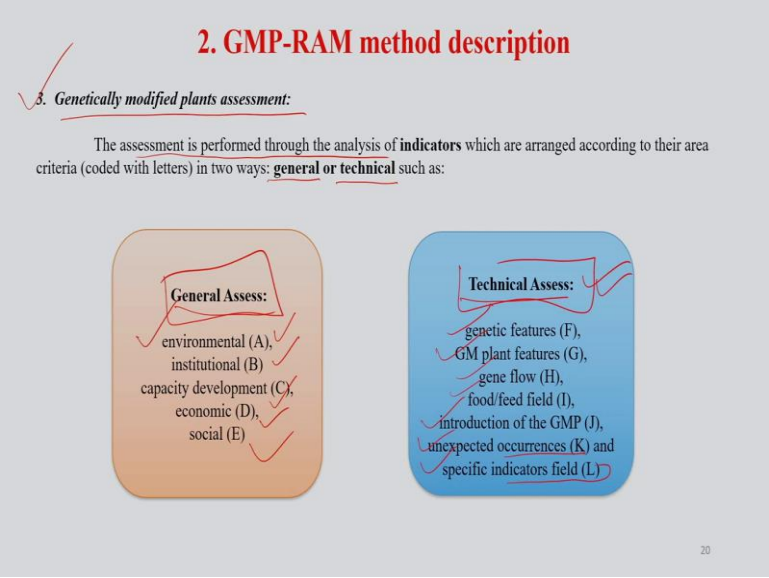
This is also a part of EIA which helps to assess the organism's impact on ecosystem and health human health. Continuing with GMP-RAM method description there are six steps involved in this GMP-RAM method and they are first Biotechnology characterization. What you do here? Genetic characterization of the plant is the first step to be performed. This step involves the physical, chemical, nutritional and reliable parameters of a product.

Next step genetic information; this is bit critical; here we need information which are relevant to the particular plants of your target their genetic configuration the genetic vigor is basically

studied under this step. What is the information that you look for? Description of traits and characteristics, information of the sequences, inserted innocent information of the sequences, inserted or deleted from the gene, genomic databases of the crop species, methods used for expression analysis, donor features means from where you are getting that particular gene. Say you might have read in articles in media that in India, one such organization has developed rice plant which can actually tolerate salt.

So, basically saline condition is not good for any plant per se. So, rice plants which are actually growing in saline areas or nearby sea areas, so there you need some kind of rice plant which can actually able to tolerate the saline environment. Now, that salt tolerant gene has been taken from some mangrove species and that gene has been inserted into the rice plant and the rice plant becomes salt tolerant. So, donor here is the mangrove plant. Now, recipient features mean how the GM crop differs from the recipient plant in terms of reproduction, survivability durability etcetera.

(Refer Slide Time: 14:21)

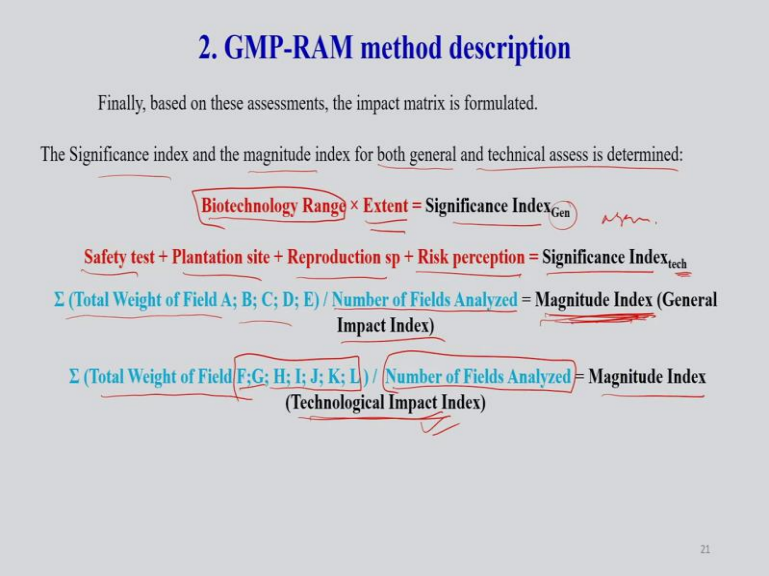


So, comparative assessment application scope means if you develop this kind of say salt tolerant rice plant, certainly it can be applied in the area where salt intrusion is there.

Third step, Genetically Modified Plants assessment. The assessment is performed through the analysis of indicators which are arranged according to their area which are you know some written in coded mechanism and these indicators or coding is done in two ways one is General the other is technical.

Now, the general assessment is done environmental, institutional, capacity development, economy and social aspect. The technical assessment is done by studying genetic features, GM plan features, gene flow, food/feed field, introduction of GMP, unexpected occurrences and specific indicators field. So, two kind of assessment genetically modified plant assessment that we carry out General and the other is technical.

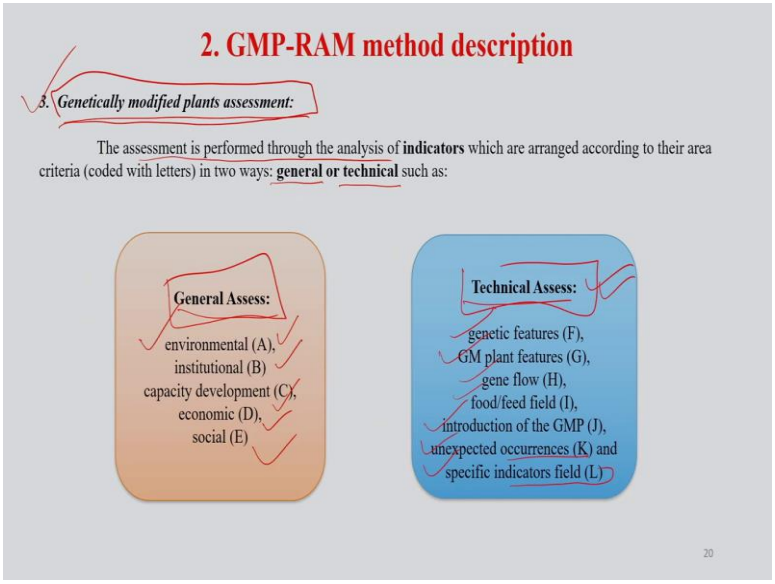
(Refer Slide Time: 15:19)



So, finally based on this kind of assessment; General and Technical assessment the impact Matrix is formulated. The significant index and magnitude index which we discussed earlier both General and Technical assessment is determined. Now, how they are actually expressed? As you see here biotechnology range here into extent equal to is the significance index which is a general assessment. Safety test, Plantation site, reproduction species, risk perception; these are actually expressed by significant index which is a technical assessment.

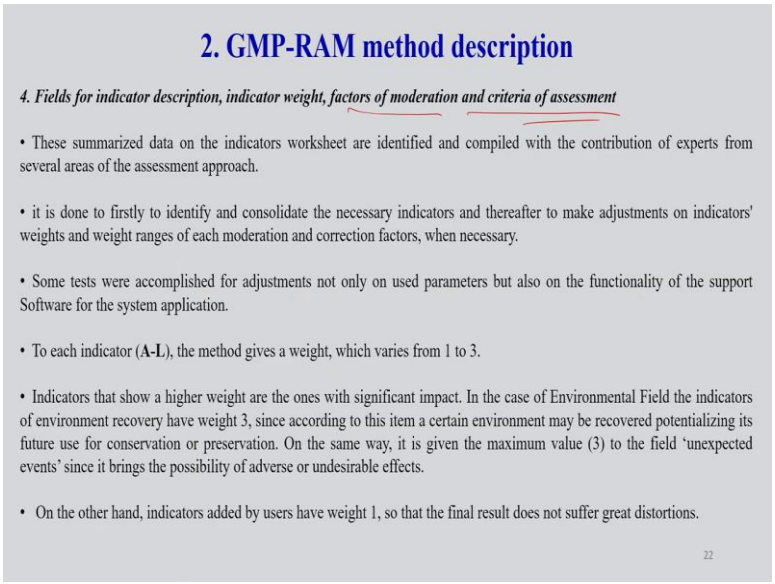
Now, how you get magnitude index which is a general impact index? By adding total weight of a field A; B; C; D; E wherever you have carried out your experiment divided by number of fields that are analyzed means 1 2 3 4 5. So, that will give you a magnitude index. Now, magnitude index for technological impact index how you will measure? Again total weight of the field F; G; I; J; K; L divided by the remaining part by number of fields that you have analyzed. So, one you get magnitude index for General impact index and another magnitude index for technological impact index.

(Refer Slide Time: 16:49)



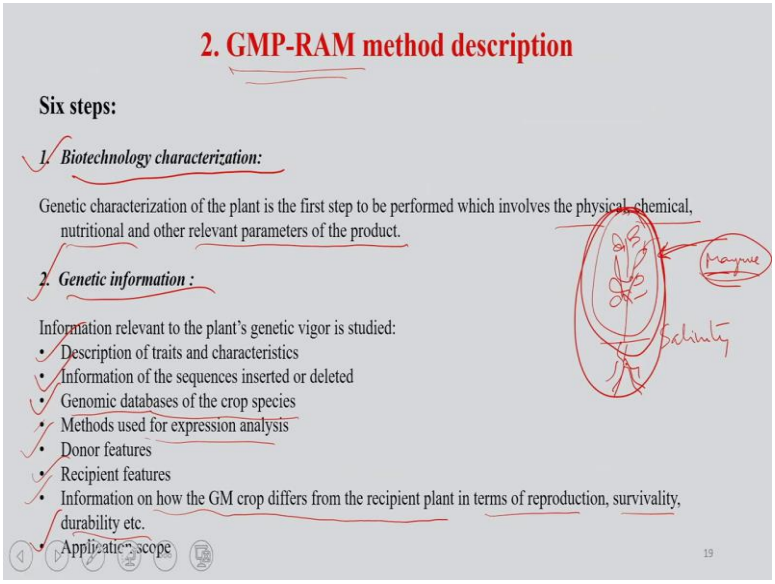
So, these two are the two assessment finally will help you to do the Genetically Modified Plants assessment GMP that you have with you.

(Refer Slide Time: 16:57)



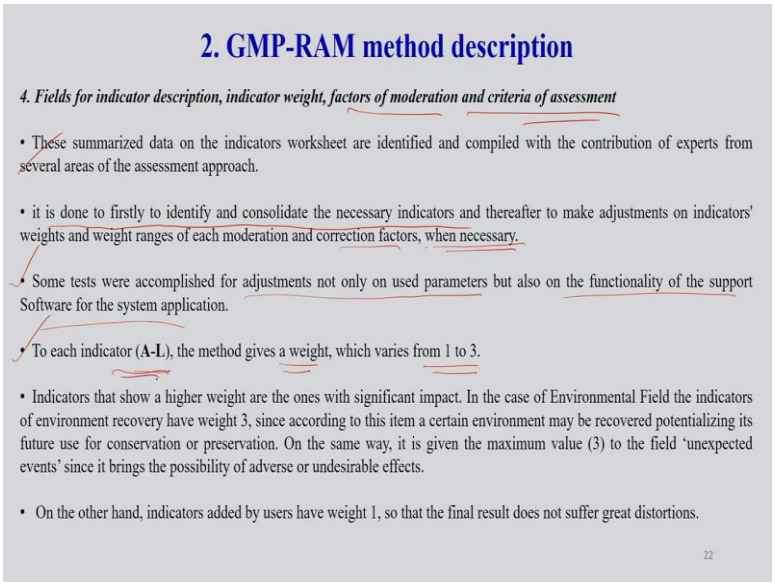
You can assess their impact number, fields for indicator description, indicator weight, factors of moderation and criteria assessment. So, we are actually discussing the second method of EIA remember the first one was LCA and then we are

(Refer Slide Time: 17:26)



discussing about the second one within second one we are discussing the various steps of GMP-RAM method of EIA.

(Refer Slide Time: 17:43)



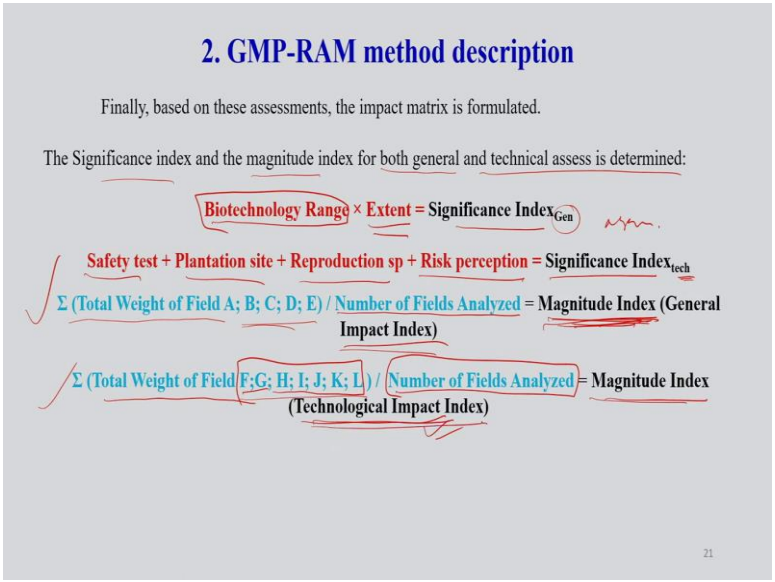
So, first one biotechnology characterization, second genetic information, third is genetically modified plant assessment and then we go for the fourth step this particular step of GMP rep method of EIA. The summarized data of the indicators worksheet is identified and compiled with the contribution of experts from various areas of this particular assessment approach.

If you recall that in previous lecture we also discussed that expert observation and expert suggestions are very important in EIA exercise. In this particular step of GMP-RAM method it is also you know done firstly to identify and consolidate the necessary indicators and

thereafter we need to make the adjustments of indicators weight and weights range for each moderation and correction factors whenever it is necessary.

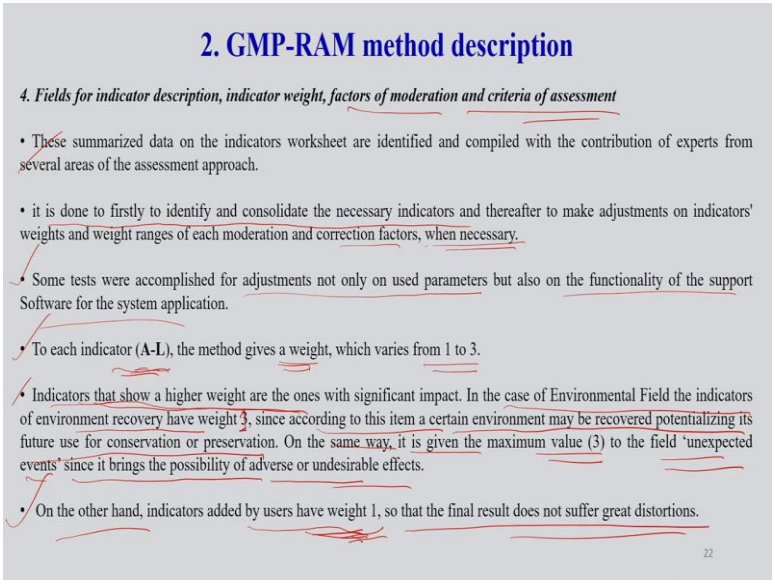
So, we will give you know certain weights for each of these indicators and then you know some correction factors if it is needed. Some tests will have to be accomplished for the adjustment not only on used parameters but also on the functionality of the support software for the system application. To each indicator A to L the method gives a weight and which varies from 1 to 3.

(Refer Slide Time: 19:17)



You remember this indicator that we have used A to L;here first set of indicator for magnitude index, General impact index A to E and then second one F to L for magnitude index technological impact and index estimation.

(Refer Slide Time: 19:31)



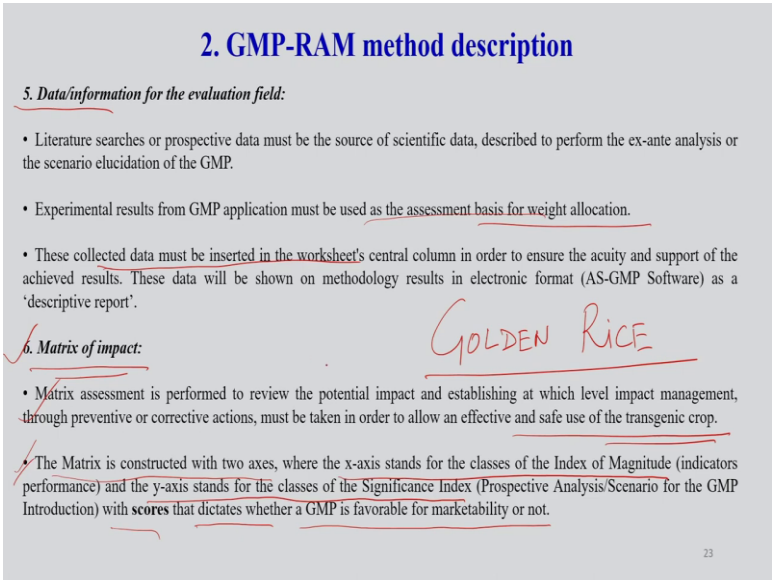
So, A to L these indicators we will give some weight to each one of these and that value will vary from 1 to 3.

Next indicators that show a higher weight are the ones with significant impact. In the case of environmental field, the indicators of environment recovery have weight 3, since according to this item in a certain environment may be recovered on the basis of its different future uses for conservation and preservation.

So, if you see that there is a potential for recovery, then you give 3 weightage. In the same way it is given the maximum value of 3 to the field of unexpected events since it brings the possibility of adverse of undesirable effect. So, I repeat again indicators that show higher weight are the ones with significant impact and in the case of environmental field the indicators of environment recovery have weight this should be 1, weight 1 since according to this item a certain environment may be recovered its future used for conservation and preservation.

On the same way it give maximum value to the field unexpected events since it brings the possibility of adverse or undesirable effects to the environment. On the other hand indicators added by users have weight one. So, that the final result does not support great distortion meaning in the environment there will not be any kind of distortions and in that situations the weight that we give is the minimum that is one.

(Refer Slide Time: 21:28)



Step 5, data information for the evaluation field. Now, here literature searches or prospective data must be the source of scientific data and describe to perform the ex ante analysis or the scenario elucidation of the GMP method. Now, experiment results from this kind of application must be used as the assessment basis for weight allocation. The collected data must be inserted in the worksheet's central column in order to ensure the accuracy and support of the achieved result. These data will be shown on methodology results in electronic format as a descriptive report.

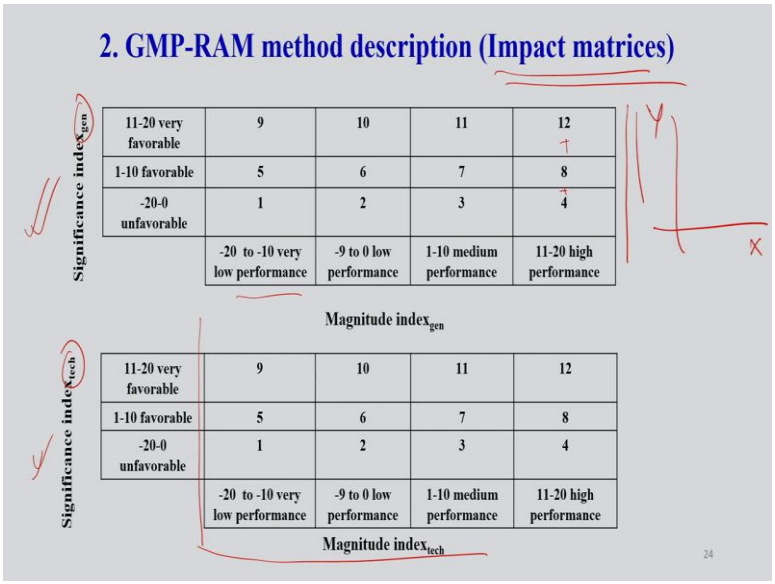
The next one next step is Matrix of impact where actually you can see that whether the impact is really taking place or not. Matrix assessment is performed to review the potential impact and establishing at which level the impact management through preventive or corrective actions must be taken in order to allow an effective and safe use of transgenic crop. As I said at the very beginning that you know GMP or GMO is a sensitive issue and we all know that how much of a discussion deliberation in every forum has taken place even now it is going on there are.

So, many you know GMPs are around but only one or two after several years of field trial checking of environmental ethics and many other things finally has been given approval to grow it. I can give you one exam example of golden rice some of you might have heard about this. Now, golden rice is the rice which has you know vitamin A rich rice, carotene Rich rice which actually helps you know for people who are having vitamin A deficiency and due to that has several other problems like eyes or other problem.

So, if for those people who are poor they cannot have the other supplementary or sources of vitamin A they can just have golden rice which is enriched with vitamin A. Now, this golden rice also has gone through lot of you know debates, testing and finally I think the country Philippines has given the permission to grow this rice at the farmer's field. That is a very big decision.

Now, like this there are many other GMPs also you know have been developed and are going through field trial or testing. The matrix is constructed with two axes where x axis stands for classes of the index of magnitude. Two type of magnitude, magnitude index General impact; and magnitude index technological index. The y axis stands for the classes of the significance index with you know different scores which will dictates whether a GMP is favorable for marketability or not.

(Refer Slide Time: 25:07)

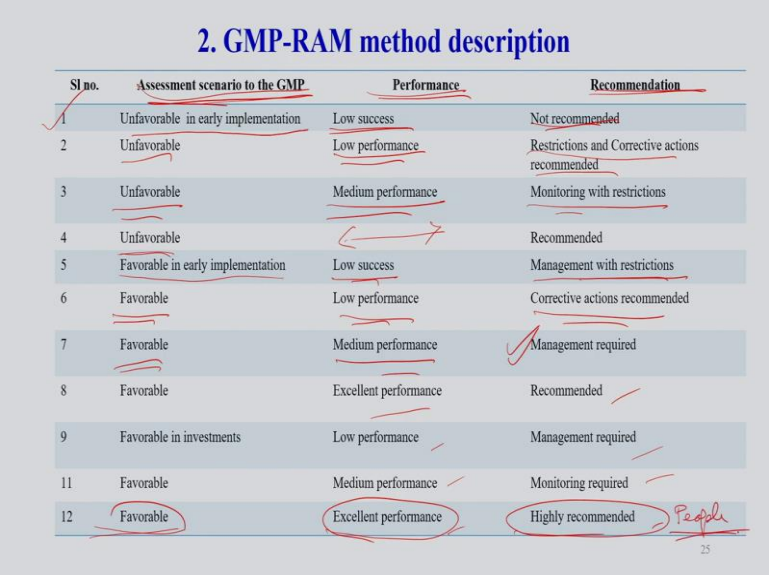


So, that test you know Matrix impact test is very important finally whether a GMPs will be actually allowed for you know common people use or not. Now, little bit on impact Matrix says actually how it actually takes place. So, if you see that two significant against index one is the general and another is technical. Now, in case of General significance index 11 to 20 if you get then it is actually very favorable. 1 to 10 favorable and you know 0 to minus 20 is unfavorable; which we call a very low performance.

Now, this index you can actually calculate like this one here you have 12 plus 8 plus 4 that means 24. So, 11 to 20 high performance significance index and 1 to 10 medium performance and then minus 9 to 0 low and minus 20 to minus 10 here very low performance. So, this is the x you know x axis and y axis that I was talking about.

Now, in case of magnitude index technology there also you will find that similar kind of values is given here. So, these values basically allow you to understand the impact of particular GMPs on the environment or surrounding other organism in the ecosystem. So, from these matrices then you take a final decision whether this particular GMPs is suitable to go for people or not but of course this is not as simple as it seems.

(Refer Slide Time: 26:55)



So, there is various other issues there are also you know different kind of social matrices, social studies also carried out for this kind of testing. Now, GMP-RAM methods of EIA as you see that there are different assessment scenario for GMPs having corresponding performance and then on the basis of performance you recommend or you cancel.You do not recommend that particular thing or you advise for certain further you know testing or further other necessary steps to be taken.

Say suppose assessment scenario unfavorable in early implementation. So, it is low success and you do not recommend. Unfavorable again low performance restrictions and corrective actions are recommended. If you find again unfavorable with medium performance you recommend for monitoring with restrictions. If you find it is an unfavorable then without any kind of performance limitation, then you actually hold your decision and you send it back for another testing and then you check that whether it is favorable in earning implementation or not.

Again if you get low success then you say management with restrictions. If then comes favorable low performance you again recommend for corrective actions. If it becomes

favorable but with medium performance recommendation is management is required. Like this way you know as per the performance level you decide recommendation.

So, finally the favorable with excellent performance it goes you know as highly recommended and at that point it goes to the people. So, people can use those particular GMPs.